FEB 8 1912

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco Cal., under the act of Congress March 3, 1879

VOL. XXVIII No. 5 SAN FRANCISCO, FEBRUARY 3, 1912 PER COPY, 25 CENTS

PARANITE

RUBBER COVERED WIRES

are made to meet all requirements of New Code Specifications

Underground, Aerial, Submarine and inside Use. Telephone, Telegraph, Fire-Alarm, Electric Light and Power Wires and Cables

"The Best For Every Purpose"

Indiana Rubber & Insulated Wire Co.

Jonesboro Indiana

ELECTRIC APPLIANCE COMPANY, 728 Mission St., San Francisco, Pacific Coast Agents

Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages 9, 10, 12.

The "Ironclad-Exide" Battery

will run an electric car more miles with less attention and less expense than any other battery ever made. It can be kept in good order with minimum attention and does not quit on a hill or in starting a heavy load. It is the vehicle battery for either cold weather or hot and for either pleasure or commercial cars.

This is the battery that it will pay Central Stations to endorse.

THE ELECTRIC STORAGE BATTERY CO.

1888 PHILADELPHIA, PA. 1912

San Francisco Sales Office: PIERSON, ROEDING & CO., 118-130 New Montgomery St.

New York, Boston, Chicago, St Louis, Cleveland, Denver, Detroit, Atlanta, Los Angeles, Portland, Or. Seattle Toronto

The Schaw-Batcher Co. Pipe Works

(INCORPORATED)

Manufacturers of **RIVETED IRON AND STEEL PIPE**

Tanks of all descriptions for Water, Oil and Gas. Single and Double Well Casing

OUR SPECIALTY: Riveted Pipe for High Pressure Engineers and Contractors for the complete installation of Pipe Lines used in the operation of Hydraulic Mines, Power Plants, Water Works, Irrigation, Reclamation, etc. We have special facilities for supplying general supplies for Mills, Mines, etc.

Office, 211 to 219 J Street **Works, 15th and B Streets**

SACRAMENTO, CAL.

San Francisco Office, 356 Market St. New York Office, 65 Reade St.

H M A

Hitchcock Military Academy

Accredited to the Universities of California. Four Departments: High School, Commercial, Grammar School and Primary. ¶ The War Department details an officer of the U. S. Army who is responsible for the military work. ¶ The climate is splendid and all out-door sports are encouraged by the principal. ¶ The campus is large and both the baseball and football teams are well known—Fine gymnasium and resident Physical Director.

For Handsomely Illustrated Catalogue Address The Principal

SAN RAFAEL - - - - - CALIFORNIA

Homans' Automobile Educator

(Fifth Revised Edition)

A Book for Owners, Operators, Repairmen, Intending Purchasers and all interested in Automobiles, giving the essential details of construction and many important points on the successful operation of the various types of motor carriages driven by steam, gasoline and electricity.

598 Pages, Profusely Illustrated. Price $2.00.

TECHNICAL BOOK SHOP

RIALTO BUILDING, SAN FRANCISCO

KLEIN TOOLS EST. 1857 TRADE MARK REG.

TRADE MARK

TOOLS OF MERIT

WORTHY OF YOUR ATTENTION

Your Money is safely invested so far as tools are concerned, if they are modern and eliminate waste, if they are practical and facilitate progress, if they are substantial and insure long usefulness.

"KLEIN TOOLS" Embody These Qualities

Write to us for free Booklet, or send 5 cts in stamps for illustrated catalog

MATHIAS KLEIN & SONS, Canal Station 29, Chicago, Ill.

MERIT SELLS

NEW CODE

Trade **BX CABLE** Mark

AND

GREENFIELD

FLEXIBLE STEEL ARMORED CONDUIT

Conduit Coil

Most Flexible and Reliable Wiring Products on the Market

Write for Descriptive Catalogue No. 43654

SPRAGUE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

Main Offices: 527-531 West 34th St., New York, N. Y.

San Francisco, Rialto Bldg. Seattle, Colman Bldg.

B273259

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

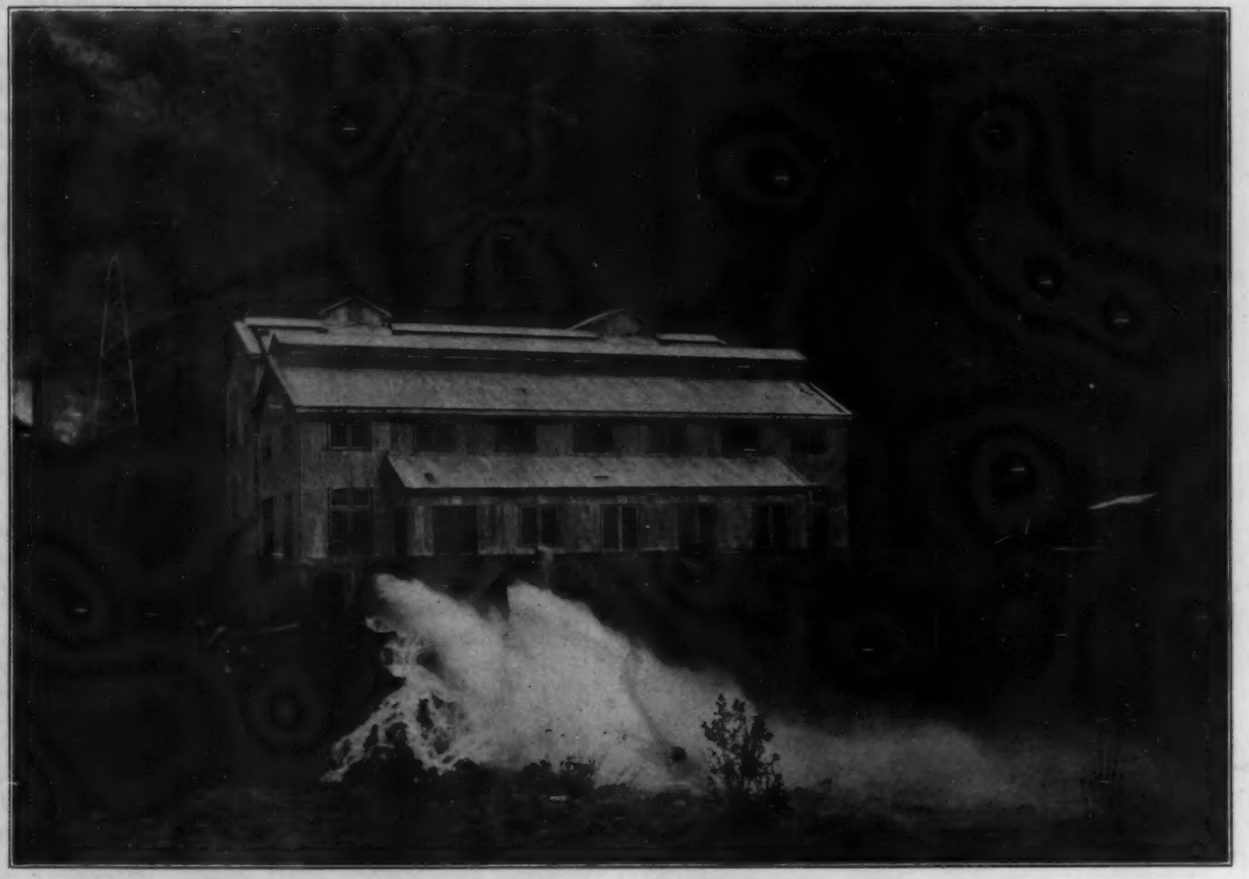
VOLUME XXVIII SAN FRANCISCO, FEBRUARY 3, 1912 NUMBER 5

[COPYRIGHT 1912 BY TECHNICAL PUBLISHING COMPANY]

THE CONSTRUCTION OF THE STANISLAUS LINE[1]

BY H. W. CROZIER.[2]

The transmission line of the Sierra & San Francisco Power Company is usually known as the Stanislaus line, on account of the fact that it transmits power developed on the Stanislaus River. A description of the line, some of the details and its construction will perhaps be of interest.



Generating Station of the Sierra and San Francisco Power Company on Stanislaus River.

The line is built primarily to transmit power from the power station on the Stanislaus River to San Francisco, where the power is delivered to the United Railroads who require from 16,000 to 20,000 kw. On account of the fact that San Francisco is located on a peninsula a considerable divergence from a direct line was necessary in laying out the transmission line on account of the necessity of going around the southern end of San Francisco Bay. The line, however, is about 134 miles long and is the shortest transmission line now delivering power into San Francisco.

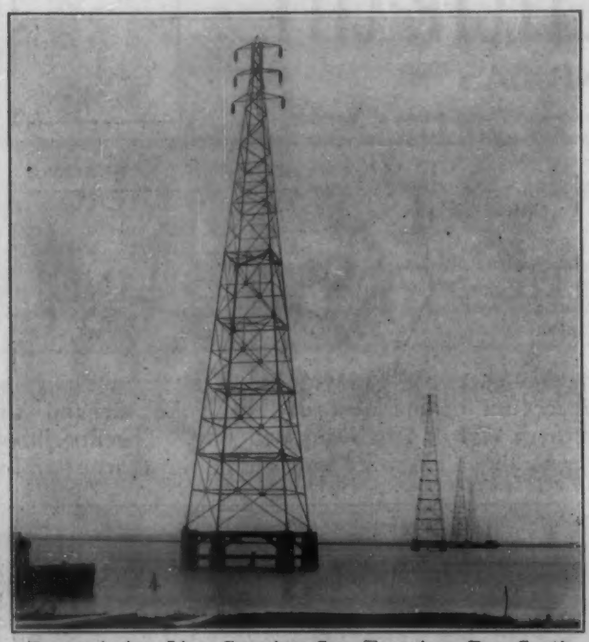
The construction of the line is of a very substantial character. Stranded copper conductors of an area equivalent to 00 are used to conduct the current, supported by suspension type insulators attached to steel towers.

In level ground the towers are high enough to support the lowest conductor 50 ft. above the ground at the tower, and the towers are spaced 800 ft. apart. In hilly or mountainous ground, advantage is taken of

[1]Paper presented before San Francisco Section, A. I. E. E., Jan. 26, 1912.

[2]With Sanderson & Porter.

the inequalities of the ground, longer spans are used where convenient and shorter towers on the hill tops. The wires are given a clearance of 25 ft. at the closest point.



Transmission Line Crossing San Francisco Bay South of Dumbarton Cut-Off.

Bay Crossing.

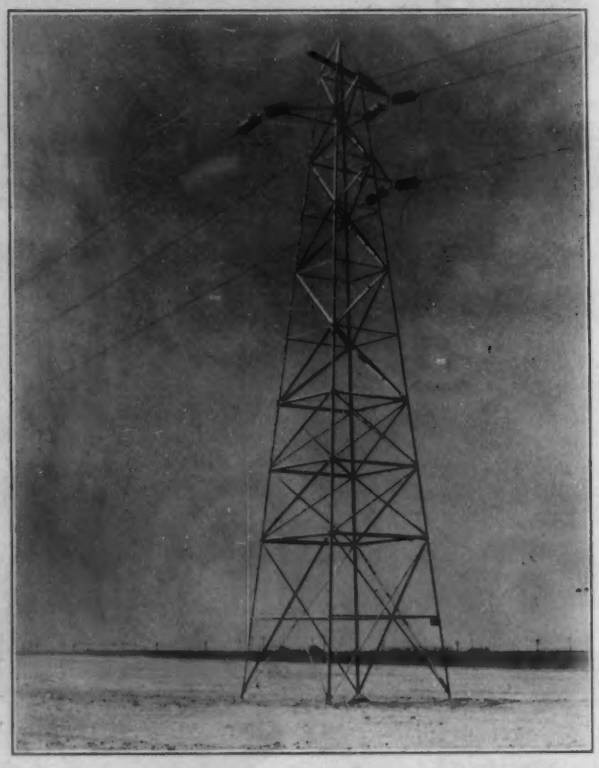
In determining the location of the line three different routes could be followed; one, crossing the bay at the Dumbarton Point close to where the Southern Pacific Railroad crosses the bay; another, further south and skirting the marshy margins of the bay; and the third, further south again but on more solid ground and parallel to the route followed by the Pacific Gas & Electric Company's transmission line, built a number of years ago. At Dumbarton Point the distance from shore to shore is considerable, about 6000 ft. The shores are flat marshy ground and there are no hills or even solid ground at all in the vicinity. The type of crossing used at Carquinez Straits was out of the question. It would be necessary to erect towers and anchors in the marshy ground on pile foundations. Surveys of the channel were made and consideration of the kind of towers and foundations gone into in detail. It was found that a 3500 ft. span would be required with two high towers, or somewhat shorter spans could be used by making one central high tower with two lower towers in the shallower water in shore. Estimates were prepared on this basis and much consideration given to the foundations required.

The long span required, the heavy current, and the deep water in which the foundations would have to be placed, made the estimates run up to a high figure. Before proceeding at Dumbarton, an investigation was started in the swamp ground on the southern end of the Bay to see if in the end it would not be cheaper and better to cross the bay at the mouth of Coyote Slough and build along the swampy ground.

This investigation immediately disclosed the fact that the crossing would be in not to exceed 27 ft. of water, and standard spans of 800 ft. previously determined on for solid ground could be used. Although the line would be nearly three miles longer, the cost of the construction was found to be very favorable, and even with the line loss and extra cost of the longer line capitalized, the estimated cost was considerably less than that of the Dumbarton Crossing. Final decision was made therefore for a line running around the southern end of the bay for the following reasons:

1. Standard tower construction same as rest of line.
2. No strain anchors for long spans.
3. Towers 162½ ft. high against 210 ft. for long span.
4. Much lighter towers on account of reduced span.
5. Lighter foundations on account of lighter towers and shallower water.
6. Practically no danger from collisions with vessels.
7. The Dumbarton Crossing has a very strong tide and vessels approaching the railroad drawbridge are difficult to handle at some stages.

The line finally used skirts the marshy margin of the bay and crosses the Coyote Slough at its mouth, and also another minor slough, the total distance being 2700 ft. Four towers were erected at this point on concrete and pile foundations. Each foundation consists of four piers containing four piles each, making 16



Strain Insulators on Transmission Tower.

piles for each foundation. The piles are surrounded by a cassion, which after being driven into a hard layer in the bottom of the bay, was pumped out, material dredged to a safe distance below the bottom, and the hole filled with concrete, suitably reinforced with steel rings and with vertical rods. On the four cylinders thus erected a structural steel frame work was built and the whole when completed was encased

in concrete, making a four legged structure containing piles which go to considerable depth and firmly braced with structural steel protected by concrete. Upon this structure was erected the towers.

Most of the craft navigating this part of San Francisco Bay are small, consisting of scow schooners, power schooners and launches. No damage is expected from collisions with these vessels, as the concrete foundations are undoubtedly strong enough to resist collision with very much larger vessels. The transmission line clears the water at high tide by 120 ft., which is ample for any vessels navigating these waters.

In addition to the crossing of the Alviso Slough there were a number of other sloughs of more or less importance which were crossed, and which it was decided by the U. S. Engineers would require clearance in some cases of 120 ft., and in other cases of 90 ft. The foundations, however, were on the banks of the sloughs and have been previously described. The towers were similar to the ones used at the Alviso Crossing, consisting of a standard 50 ft. tower with a 62½ ft. extension where 90 ft. clearance was required, and 87½ ft. extension where 120 ft. was required.

In the erection of the line on the marshes it was not possible to use horses on account of the soft character of the ground. The bay, however, made it possible to use launches and barges on which donkey engines could be mounted. Transportation was convenient and the long stretches of marsh were crossed by donkey engines mounted on skids, which by their own power hauled themselves along. It is estimated that perhaps in the end the cost of hauling the material to the site and erection of the line is not any more than would have cost on more solid ground after we except, of course, the cost of the erection of the foundations which would not have been required on solid ground.

A word about the operation. The power station has been in operation for three years; the transmission line into San Francisco for 15 months. The high grade of the service given can be easily seen in the much more reliable service now given by the United Railroads, than before this system supplied their needs. All complaints on account of delayed cars, about which the newspapers usually had something every day or so, have entirely stopped. From an authoritative source it is learned that the total interruptions to service during the year 1911 for the whole system covering hydraulic, transmission and all other causes amounted to 24 hours. This is certainly an excellent record and it is known that a very small part of these 24 hours is chargeable directly to transmission line.

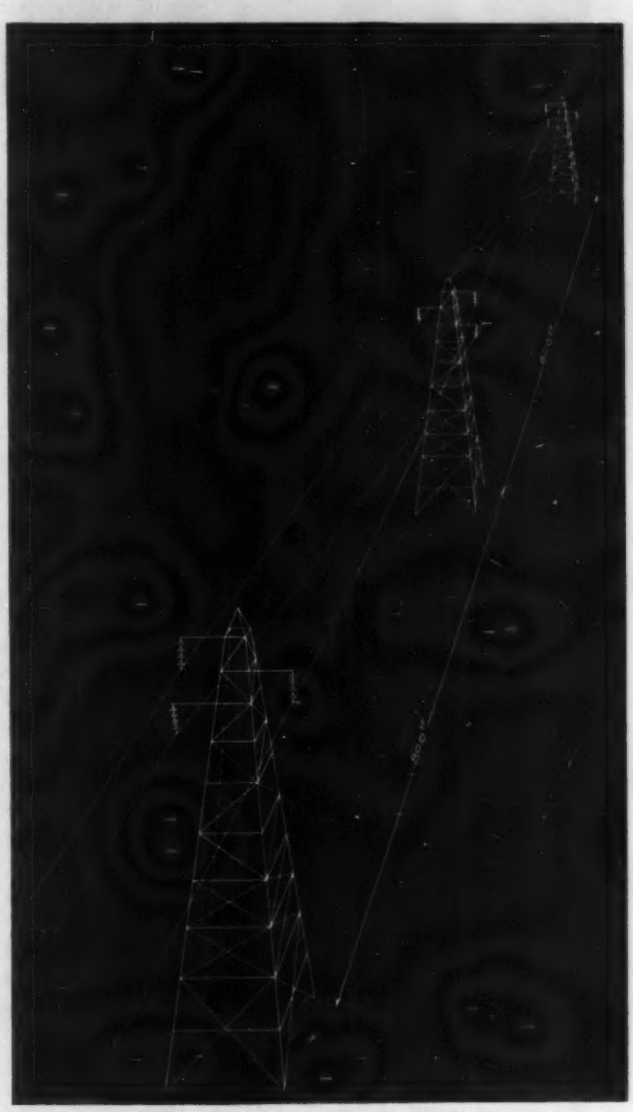
Insulator troubles on this line have been nil, first due to the design, and second, to the very careful inspection which the insulators were given in the factory and after erection. The insulation provided is undoubtedly ample, and no trouble whatever has been had due to fogs. The few interruptions during 1911 were caused by occurrences beyond the control of the company, one due to a boy climbing a tower, and the others to interference in one way or another.

The towers: The towers were manufactured by the Aermotor Company of Chicago. They consist of four corner angles connected by horizontal girts and by diagonals, and supporting three double crossarms. No part of the tower is less than ⅛ in. thick, and no rods are used than ½ in. diameter; ¾ in. and ⅞ in. bolts at crossing of diagonals and other unimportant points.

There are three joints in the vertical angles dividing the tower into four parts, each approximately 15 ft. long. By leaving off the lower 15 ft. a shorter tower is obtained which is used in the hilly country.

The conductors are supported in two vertical rows of three each. The rows are 15 ft. apart and the conductors are 9 ft. apart vertically.

Foundations: A steel foundation for each leg is used, consisting of two 3 in. x 2½ in. x ¼ in. angles 6 ft. 6 in. long, on the end of which, and at right angles, is fastened a 12 in. channel 2 ft. long. These foundations are placed in a hole excavated for the purpose and well tamped.



Line Transposition.

Galvanizing: All parts of the towers are galvanized by the hot process and will stand the tests prescribed in the Western Union specifications for galvanized wire.

Erection: The towers as received at the railroad station consist of a lot of angles, rods, and for each

tower a box of bolts and other small detail parts. This material is hauled to the sites selected for the tower. A careful man is put in charge of this work, as it is quite easy to forget some essential part. All the parts

Insulator Arcing at 205,000 Volts in Rain Test.

are well marked with numbers and a printed list furnished by the Aermotor Company, so that with care no difficulty is experienced in handling the material. The four holes for the foundation are dug and the foundation parts installed with the aid of a steel template. The excavated material is shoveled in the hole again and tamped like any other work.

The tower is assembled first by putting together the sides on the ground, standing them on edge, and then bolting on the remaining pieces. Every part except the insulators is installed on the towers on the ground.

Erection: The tower perviously assembled is moved to the foundations, the ends of which are projecting above the ground. A piece of pipe with brackets riveted on it to bolt to the legs of the tower, is laid against the foundations and acts as a trunnion during hoisting of the tower. A steel cable is attached to the tower near the top and let over a gin pole, which stands up at the base of the tower. Blocks are attached to this steel cable and anchored about 400 ft. ahead to steel gads driven in the ground, or if the ground is too soft, to a dead man, previously buried. A line is also fastened to the tower and carried back to act as a back guy. When all is ready a team is hitched to the blocks and the tower hoisted, the gin pole dropping out as soon as the top of the tower has moved upward about 20 ft. The tower properly restrained by the back guy is attached to two of the foundations and bolted up and then after the pipe is removed from the two back foundations, a slight additional pull raises the back legs of the tower and these are bolted in place.

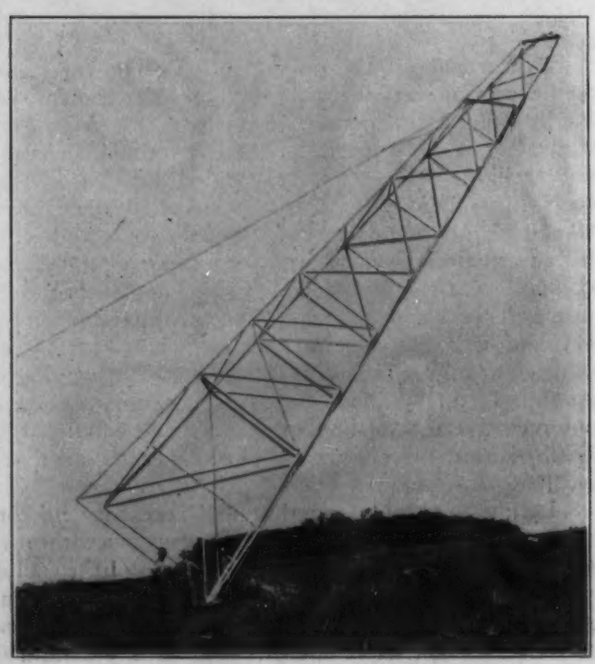
In hard ground foundation bolts are put down in the rock and cemented in, and in soft ground other foundation means are used, which will be described later. The towers and methods of erection, however, are the same. In some places near the power house the towers were erected by being built up in place on account of its being out of the question to erect towers by the ordinary means, on account of the mountainous character of the country.

In addition to the standard towers certain towers were required for the angles in the line. These angle towers were the same as the standard towers in design and differed only in size of the legs and the bracing.

The standard 50 ft. double circuit tower weighs as follows:

Standard tower	4440 lbs.
Foundation	964 lbs.
	5404 lbs.
35 ft. tower 800 lbs. less.	
30 degree angle tower	5324 lbs.
Foundation	775 lbs.
	7099 lbs.
42 degree angle tower	5623 lbs.
Foundation	2055 lbs.
	7678 lbs.
90 degree tower	9140 lbs.
No foundation.	

The 50 ft. tower is 75 ft. 6 in. high, which added to foundations, makes 82 ft. overall. The angle towers, it will be noted, do not weigh very much more



Hoisting Tower Into Position.

than the standard towers. This is because they differ from the standard towers only in having heavier corner posts and heavier diagonal bracing. All angle towers above 10 degrees have concrete deposited in the foundations for additional security.

Insulators: The insulators used consist of a string of 5 similar elements. Each element consists of two porcelain shells, a galvanized malleable iron cap and a central galvanized steel eyebolt. A ½ in. pin and ¼ in. cotter pin complete the element.

The insulators were supplied by the Locke Insulator Manufacturing Company, working under patents owned by Sanderson & Porter.

The porcelain shells which make up the element are tested in the factory by applying 60,000 volts until the pressure has been maintained for two minutes continuously. After testing, porcelain and steel parts are cemented together and tested assembled by applying 90,000 volts between the cap and the "U" bolt until the pressure has been maintained for two minutes continuously. These are the standard proving test applied during manufacture to every insulator.

The insulators were tested out thoroughly at Victor, N. Y., by the late J. D. E. Duncan in 1908 with the following results:

One insulator with 100,000 volts applied stood 6000 lb. tension and failed at 6500 lb. by the breaking of the outer shell; O. K. electrically. Another stood 7200 lb. before breaking of the shell and finally failed by pulling out of the U bolt, the load falling to 5800 lb. during this part of the test. Some units have stood 8000 lb. maximum and all tested stood at least 5500 lbs without distress.

At Schenectady on January 20, 1909, four elements in series were subjected to a spray from above and the current measured by a voltmeter in series with the following results:

200,000 volts	.004 to .005 amperes
224,000 volts	.011
215,000 volts	.012

Three elements in series with a heavy spray which gave a precipitation of 1½ in. in 5 minutes measured by a rain gauge showed a current varying from .5 miliamperes to 9 miliamperes, while the applied voltage was raised from 100,000 volts to 162,000 volts. With additional sprays, so that there were two from above and one from below, the current reached 12 miliamperes and the voltage dropped to 40,000 volts.

On the line the insulators are hung from a trunnion bolted to the end of the tower crossarm and support the copper conductor by a clamp 8 in. long. The trunnion on the end of the arm supports a short steel piece which fits between the jaws of the cap. The ½ in. steel pin of the insulator completes the joint, allowing swing in any direction. The clamp for holding the wire consists of three parts, the clamp proper, the clamp cap and the eyebolt. There are four bolts for holding the clamp together and securing the conductor. The eyebolt is used for the purpose of allowing complete flexibility. A copper sleeve 2/100 in. thick is bent over the copper cable to protect it from any roughness of the clamp, and also to avoid the possibility of localization of the stresses on any strand of the copper conductor.

The same insulators are used for dead ending as are used for supporting the cables. The line is dead ended on the angle towers and in places on straight line towers. The insulators in this case lie in a horizontal position and are found to operate as well in this position as in the vertical position. A strain clamp is used to hold the cable. This consists of two pieces held together with 6¾ in. bolts. The cable lies in a groove in the clamp and is protected from injury by one of the copper sleeves.

The copper conductor is a strand of six wires around a hemp core. The wire is medium hard drawn and was furnished by the American Wire & Steel Company. The area of the copper is the same as a 2/0 wire and the outside diameter of the strand is ½ in. Joints are made by twisting in the same manner as with a McIntyre sleeve. The joint differs from a McIntyre sleeve joint only in being made with a flattened copper tube, large enough to take the two conductors, instead of with a sleeve consisting of twin tubes brazed together. A hemp core was used for two reasons, first mechanical, to allow sufficient flexibility so that all the wires in the strand could accommodate themselves to the load and second to get a larger diameter to reduce to a certain extent the energy loss between conductors (Corona effect, etc.)

Foundations: The steel foundations previously described are satisfactory as long as the ground is of such a character as will permit their use.

As soon as the swampy shores of the bay were reached, it became necessary to use piles to get the necessary bearing to support the weight and also to provide against uplift. To protect the piles above the water line and provide security against marine borers, and at the same time make a pemanent and substantial job, a concrete cap was installed.

Three classes of foundations were designed.

First, consisting of one pile at each corner for a 50 ft. tower. Second, consisting of two piles at each corner for a 112½ ft. tower and third, consisting of three piles per corner for 137½ ft. tower. A fifty foot tower supports the lower conductor 50 ft. above the ground and is 75½ ft. to the apex, the apexes of the 112½ and the 137½ ft. towers are similarly 25½ ft. higher than the lower conductor.

The standard foundation consists of one pile driven at each corner, the earth dug out after driving, the pile cut off at mean low water line. Two 1¼ in. anchor bolts, 6 ft. 6 in. long are attached to the pile with ⅞ in. lag screws and the pile and bolts covered with a cap of concrete. There are four ⅞ in. reinforcing bars in the corners of the concrete block thus formed and 5½ in. bars in the form of hoops. The block is 3 x 3 ft. at the bottom and 18 in. x 18 in. at the top and 6 ft. long surrounding 2½ ft. of the end of the pile. The tower is later installed on the foundations. A special clamp bolted to the tower legs provides for the attachment to the anchor bolts.

The other foundations are constructed similarly. The concrete cap is of course larger to surround the additional piles. The concrete caps covering the groups of two piles are 3 x 5 ft. on the bottom. The piles are driven so as to all lie in the diagonal of the tower.

It was required for the 50 ft. towers that one pile be driven at each corner unless the penetration of the last blow of a 2800 lb. hammer falling 8 feet, shall be greater than one inch, in which even an additional pile shall be driven on the diagonal line of the base of the tower and outside the first pile and 30 in. center to

center. The piles required ran from 25 to 70 ft. and usually averaged in the neighborhood of 35 ft. The work was done with a pile driver mounted on skids and movements were made in the usual manner, as long a cable as possible being carried forward for this moving.

PRESERVATION OF POWER TRANSMISSION POLES.[1]

BY W. R. WHEATON.[2]

The increasing cost of power transmission poles in recent years and the high maintenance charges have turned the attention of power companies to some process to increase the life of the poles and to cut down the maintenance charges. The first cost of the poles has nearly doubled in the past six years, and these two factors have been largely responsible for the interest shown by operating power companies in pole preservation.

In March, 1908, the San Joaquin Light & Power Corporation set a line of Western yellow pine (Pinus ponderosa) poles. The line is about 30 miles long and contains approximately 600 poles. These poles were cut in the Sierras above Fresno at an elevation of about 4000 ft., and were thoroughly seasoned before treatment. Some of the poles received a brush treatment with carbolineum and with creosote, and the rest were treated in an open tank with creosote, zinc chloride and crude oil. The butt only was treated. Western yellow pine is very susceptible to a preservative treatment. Some of the butts were thoroughly penetrated with creosote and with zinc chloride, the average penetration (at the ground line) being 3 in. The penetration with crude oil averaged about 1½ in. The crude oil used was a heavy oil of asphaltum base supplied from the Kern River fields. In order to get a comparative life of the wood treated and untreated, stubs of untreated timber were set along the line about a mile apart. The writer inspected this line in June, 1910, at which time it had been set for twenty-seven months. The untreated stubs set along the line were completely rotten. Of the poles brush-treated with carbolineum and creosote the conditions were about the same, a large percentage of each showing signs of decay; 27 per cent of the poles that had a brush treatment with creosote showed signs of decay, and 29 per cent of the poles that had brush treatment with carbolineum showed decay, while 45 per cent of the poles treated with crude oil were slightly attacked by decay. Of the poles treated with zinc chloride, 28 per cent showed attack by decay. The poles treated with creosote in the open tank (over 50 per cent of the entire line were treated in this way) were all perfectly sound and showed absolutely no signs of decay.

In August, 1911, two of the poles in this line which had received a brush coating of creosote fell over, owing to decay at the butt. During August and September, 1911, the line was gone over and all of the poles which had had a brush treatment of crosote or carbolineum were so badly decayed that they were strapped to a creosoted cedar stub.

The above results speak for themselves. The value of the experiment is apparent and is enhanced by the fact that the timber used will entirely decay, without treatment, in a year.

The San Joaquin Light and Power Corporation is now treating Western red cedar poles at the butts only by the open-tank process. There is no necessity for treating the top, since the top is not subject to decay. With this process the outer ring of sap wood on the cedar poles is filled with creosote, and if the timber is thoroughly seasoned before treatment there is little difficulty in accomplishing this. The penetration varies from ½ in. to 1 in. with an absorption of from 7 lb. to 9 lb. per cubic foot. As for the efficiency of the treatment, treated and untreated cedar poles have been set for four years. The creosoted poles are still perfectly sound, while the poles set untreated have decayed through the sap wood and into the heart.

The question has been asked why zinc chloride, copper sulphate or some preservative other than creosote has not been used to cut down the treatment charges. It was found that several poles treated with chloride of zinc were, after the installation of irrigation systems, in the middle of irrigated fields. The zinc was washed out of them, and the poles had to be replaced after a service of two years. The saving in the cost of treatment by the use of a metallic salt would not mean a saving in the end if many such replacements took place. A 50-ft. creosoted pole placed in the line means an investment of about $25. The use of chloride of zinc would cut this cost to about $24.25, and the saving is too small to be considered against the possibility of the loss of the preservative by leeching out after one or two years.

[1]Abstract of a paper read at the annual meeting of the Wood Preservers' Association, Chicago, Ill., Jan. 16-18, 1912.

[2]Timber engineer, San Joaquin Light & Power Company.

NEW INCANDESCENT LAMPS RECENTLY STANDARDIZED.

The year 1911 marks the advent of the drawn wire filament Mazda lamp. This development, the most important in several years, has opened up new possibilities, both in the manufacture and use of high efficiency lamps. Several new sizes of lamps have been added to the standard lines. Regular Mazda lamps for 100-130 volts are now to be had in the 15 and 20-watt sizes in straight sided bulbs, and 15-watt sizes in 2 5/6 in. round bulbs. For voltages between 200 and 260 a 25-watt regular Mazda lamp is now available.

A complete line of Gem and Mazda lamps for street railway service has just been brought out. This includes 35 and 54 watt Gem lamps for burning five in series on 500 to 650 volts. For gauge light service Mazda lamps of the sign type are now made in 2½, 3½ and 5 watt sizes, so selected for current as to operate in series with regular car lamps. The use of regular Mazda lamps in street cars has been proven entirely practicable by numerous service tests under various conditions. Most of the above lamps are derived from regular multiple lamps by operating them at reduced efficiency and power consumption.

To the train lighting list has been added a 10-watt Mazda lamp which has already been used to a large extent as a berth lamp. Among the regular Gem lamps is now listed the 30-watt size in a 2½-inch bulb. These will supply the demand for small incandescent lamps of about 8 or 10 c.p. or replace the similar carbon lamp.

WATER CONSUMPTION FROM INDICATOR CARD.[1]

BY ROBERT SIBLEY.

To obtain the actual water consumption used in an engine cylinder is a performance of utmost importance in the practice of steam engineering. There are many ways of computing the water consumption with a more or less degree of accuracy. A rough and ready method is to observe the pressure at which the steam enters the cylinder, in other words observe the boiler pressure and measure the point of cut-off of the steam in the cylinder. By reference to steam tables we can find at once the weight of one cu. ft. of steam at the particular pressure under which the cylinder is operating. Now by computing the volume of steam entering the cylinder up to the point of cut-off and then multiplying this volume in cu. ft. by the weight of each cu. ft. of steam, which constant we have already taken from the steam tables, we can arrive at an approximate value for the steam consumption per stroke. If next we multiply by the number of strokes taking place per hour we are at once enabled to compute the entire steam consumption per hour in the operation of our engine.

In a word if N represents the number of strokes per minute (in a double acting engine this is twice the number of revolutions per minute), l is the distance in feet from the beginning of the stroke at which the point of cut-off takes place, a the area of the cylinder bore in sq. ft. and w the weight of one cu. ft. of steam at boiler pressure, we have that the total water consumption per hour is

$$W = 60\,w\,a\,l\,N \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

As an example let us take the same engine used in computing the horsepower in the last lecture. It will be recalled that this engine operates at 120 r.p.m., its cylinder bore is 18 in., the point of cut-off 6 in. from beginning of the stroke, and the boiler pressure 80 lb. gauge.

Since 80 lb. gauge is 94.7 lb. abs. I look in my steam tables under 94.7 and find w = 0.2147. Hence we have

$$W = 60\,w\,a\,l\,N$$

$$= 60 \times .2147 \times (.7854 \times 1.5^2) \times \frac{6}{12} \times (2 \times 120) = 4175 \text{ lb.}$$

It is interesting to note in passing that our engine in question for its particular type has a reasonable economy, for since we have formerly found it capable of developing 175.8 h.p., the water consumption per horsepower is, then $\frac{4175}{175.8} = 23.75$ lb.

The Buckeye Engine Company has prepared in their catalog an interesting table on the basis of pressures that result in practice with a constant boiler-pressure of 80 lb. and different points of cut-off with Buckeye engines and others of similar clearance.

It will be seen that while the best indicated economy is when the cut-off is about at 0.15 or 0.20 of the stroke, giving about 30 lb. mean effective pressure and a terminal 3 or 4 lb. above atmosphere, when we come to add the percentages due to a constant amount of unindicated loss, as per sixth column, above, the most economical point of cut-off is found

Cut-off Part of Stroke.	Mean Effective Pressure, lbs. per sq. in.	Total Terminal Pressure, lbs. per sq. in.	Indicated Rate, lbs. Water per I.H.P. per hour.	Assumed.		Product of Cols. 1 and 6.
				Act'l Rate.	% Loss.	
0.10	18	11	20	32	58	5.8
0.15	27	15	19	27	41	6.15
0.20	35	20	19	25	31.5	6.3
0.25	42	25	20	25	25	6.25
0.30	48	30	20	24	21.8	6.54
0.35	53	35	21	25	19	6.65
0.40	57	38	22	26	16.7	6.68
0.45	61	43	23	27	15	6.75
0.50	64	48	24	27	13.6	6.8

Theoretical Compared With Actual Water-Consumption.

to be about 0.30 of the stroke, giving 48 lb. mean effective pressure, and 30 lb. terminal pressure. This showing agrees substantially with modern experience under automatic cut-off regulation.

As the hot steam enters the cylinder which has just been cooled by the outgoing exhaust steam a portion of this incoming steam is condensed into water, consequently we are unable to get an exact valuation for this steam by the method just outlined. After the steam has been cut off from entering the cylinder we have previously found that it expands, following very closely the isothermal law of expansion. Toward the end of the stroke the pressure, having been reduced by the expansion of the steam permits the water, which condensed at the earlier part of the stroke, to re-evaporate into steam, hence about 2/3 down along the line of expansion we will arrive at a point which in all probability represents the condition we are looking for, namely, uniformity.

Looking now at Fig. 1, let us follow with our eye down along the expansion line from the point B to a point P which is about the proper place on the expansion line from which to make our water consumption computation. Having previously drawn the absolute zero line O M on the indicator card, at the point P we now let fall a perpendicular P C to the line O M. Since our indicator card is drawn to a definite scale we now read off our scale the pressure P C. Let us call this pressure p. We next scale off the distance F C in proportion to the total stroke F M and we have at once the distance out from the beginning of our stroke at which our point P is located. It is

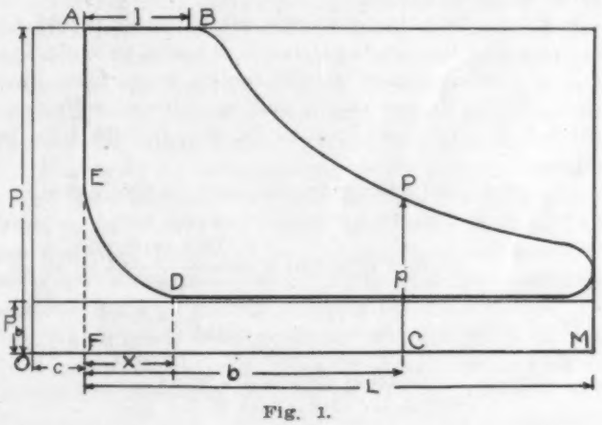


Fig. 1.

[1] This paper comprises the Nineteenth Lecture of the series appearing in these columns entitled "Primer of Applied Thermodynamics."

evident now if we multiply the volume of the steam enclosed at this point by the weight in lb. per cu. ft. we can determine the steam supply per stroke.

If a is the area of the cylinder bore in sq. ft., b is the distance in feet that the point P is located from the beginning of the stroke and c is the clearance in feet, then the cubical contents of the entrapped steam is a $(b + c)$ cu. ft. If now this steam weighs w lb. per cu. ft., the total weight of steam is wa $(b + c)$.

All of this steam however is not entirely utilized per stroke for a certain portion of it is still in the cylinder at the point of compression. If x is the distance in feet that the point of compression is located from the beginning of the forward stroke, c is the clearance in ft. and P_b the back pressure in the cylinder and w_1 the weight of a cu. ft. of the steam, then $w_1 a (x + c)$ is the weight of steam cooped up in the cylinder at the end of the stroke.

In order now to compute the net amount of steam utilized in each stroke in the cylinder we should take the difference between these two quantities or

Net steam consumption per stroke $= wa (c + b) - w_1 a (c + x)$.

Since there are N strokes per minute or 60N strokes per hour the total consumption of steam per hour in pounds is

$$W = 60 N [wa (c + b) - w_1 a(c + x)]$$
$$= 60 N a [w (c + b) - w_1 (c + x)]$$

Returning again to our former example, let us compute the water consumption per horsepower per hour by this more exact method. Fig. 1 represents an indicator card for this engine which in addition to the constants above listed, it will be recalled, has a clearance of 1/10 stroke, the stroke being 24 in. The point of compression takes place 20 in. from the beginning of the return stroke, and the back pressure is 1.3 lb. gauge.

From the card as shown we scale off p and find it to be 45.5 lb. abs., and also b is found to scale 15.04 in. By reference to steam tables w is then found to be 0.1076 lb. per cu. ft. and w_1, corresponding to a pressure of 1.3 + 14.7 or 16 lb. abs. is 0.0404 lb. per cu. ft.

Hence substituting in our formula, we have

$$W = 60 N a [w (c + b) - w_1 ((c + x)]$$
$$= 60 \times (2 \times 120) \times \left(\frac{.7854 \times 18^2}{144}\right) \times$$
$$\left[0.1076 \left(\frac{2.4 + 15.04}{12}\right) - 0.0404 \left(\frac{2.4 + 4}{12}\right)\right]$$
$$= 26960 [0.1563 - 0.0215]$$
$$= 26960 \times 0.1348 = 3634 \text{ lb. per hour.}$$

Hence water consumption per indicated horsepower per hour is

$$\frac{3634}{175.8} = 20.65 \text{ lb.}$$

In performing a test to determine the water consumption per hour by actual measurement it is often found that leakage occurs in the circulating water system and consequently the test is inaccurate. There are various methods used in practice to check up the results of tests in order to see if any leakage has taken place. In those plants operating by means of a surface condenser, that is, one in which the circulating water and condensing steam do not mingle, a test known as the silver nitrate test is found very satisfactory in order to determine whether leakage has taken place or not.

Years ago the chemist found that if silver nitrate is mixed with water having only a very slight amount of salt in solution a white precipitate is formed. Hence in those plants which utilize sea-water for their circulating water this quantitive test is of much importance. Chemically speaking the reaction which takes place when silver nitrate is poured into water containing salt in solution is

$$Ag NO_3 + Na Cl = Ag Cl + Na NO_3$$

If we are able to measure exactly the amount of leakage which has taken place we can then make a proper correction for our total water consumption. To this end engineers have found it practical at times to pass the circulating water through the pipes and maintain the same vacuum in the condenser that is maintained when the engine is in operation. If now the water coming through is carefully weighed, and the test covers a period of three or four hours, a proper determination of the leakage can be made. It is needless to say that any appreciable leakage should be determined and stopped before a test is made. Careful tryouts should be made previous to the running of the test and after its completion, to assure against leakage.

In the case of reciprocating engines operating by a throttling governor, that is one in which the point of cut-off remains constant, we now propose to show that, when the water consumption is plotted as ordinates and the power development as abscissas, a straight line is the result.

We have previously found that the forward pressure in the steam engine is equal to $p_1 \left(\frac{1 + \log_e r}{r}\right)$ in which p_1 is the boiler pressure and r the ratio of expansion of steam in the cylinder. If now n is the number of revolutions per minute and V the cubical contents of the steam cylinder, the total volume of steam consumed per hour is evidently 120 (nV). Let us assume that the expansion in the cylinder is isothermal. Under these conditions we have previously seen that $p_1 v_1 = k$, in which v_1 is the initial volume of the steam and k is a constant. Hence if we let W equal the weight of steam consumed per hour we now see that

$$W = \frac{120 (nV)}{v_1} = \frac{120 (nV p_1)}{k}$$ when considering the throttling governor, and since the point of cut-off is a constant, all of the factors in the above expression are constant except p_1. Hence if z is a constant we have $W = zp_1$.

Since the forward pressure is equal to $p_1 \left(\frac{1+\log_e r}{r}\right)$ it is then evident that $p_1 = cp_1$ or $W = \frac{z p_f}{c}$. We have previously found that the mean effective pressure acting upon the cylinder head is equal to the forward pressure less the back pressure,

$$\text{or M.E.P.} = (p_f - p_b) \therefore W = \frac{c}{z}(\text{M.E.P.} + p_b).$$

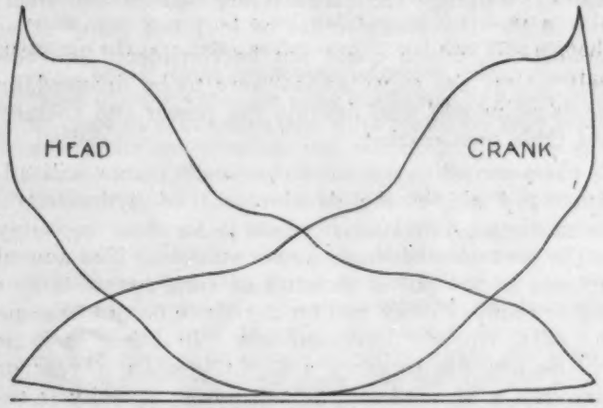
In the study of analytic geometry we have seen that a straight line is represented by the formula $y = mx + b$. Comparing this equation with the one above we see at a glance that the water consumption is represented by a straight line when plotted to scale. It will be remembered, however, that we have assumed isothermal expansion for the steam engine cylinder. As a matter of fact, to be absolutely accurate this line inclines slightly upward when plotted.

Hence when a test for water consumption has been made on the steam engine, if the same does not plot very approximately into a straight line we know at a glance that some error must have been made in the test and most frequently the error is that of leakage from the circulating water.

Although the above is only true in the case of a throttling steam engine, in the case of a turbine whether is be governed by throttling or otherwise this curve of water consumption is a straight line and is known as the Willan's law.

Thermotwisters.

1. The indicator card given below is that of a simple engine of 12 inch stroke, 12 inch piston diameter, 1⅛ inch piston rod diameter and 235 revs. per min. The scale of the



Problem in Water Measurement.

highest pressure point shown on the card is 80 lb. gauge. What is the indicated water consumption per hour, without making allowance for piston rod diameter.

2. Compute the indicated water consumption per hour, making full allowance for piston rod displacement.

HYDROELECTRIC ENTERPRISE IN PERU.

Arequipa is the second city in size and in commercial importance in Peru. It has 40,000 population, and is in the interior four hours by rail from the busy port of Mollendo. The hydroelectric power station of the Sociedad Electrica de Arequipa (Ltda.) has four Voith turbines coupled direct to Siemens-Schuckert Werke generators. The company is capitalized at $300,000, on which 10 per cent annual dividends have been paid from the beginning. Gross earnings have climbed from $2590 a month in 1905 to $7300 a month in 1911, while operating expenses since the present plant was installed have slowly but steadily been reduced.

WHEN DOES IT PAY TO DEVELOP WATER POWER?[1]

BY J. R. THOMPSON.

In a diversified country, such as the Northwest, to give any fast and set rule for a subject like this would be impossible. The purpose of this paper is to deal solely with the power house end of electric power generation, and to show one of the prime reasons why many developments have not been made and why in many cases it has rendered the installation of a steam generating plant imperative. While these developments of course, are dependent upon the market for the gross income, their annual increase to some extent may be influenceed by expectations. "Expectations" I shall take up later, but for the present they shall be considered as parts of the proposed assets which affect the gross income and are to be carefully considered and in most cases seriously avoided.

In the States of Oregon, Washington and Idaho there are innumerable hydraulic developments, which total several million horsepower, the exact amount I do not profess to know with any degree of accuracy. Numerous estimates have been made of from 3 to 5 million horsepower and by this is meant power that can be developed for each hour in each day and every day in the year. In the same territory there are generated by water power and steam plants together, approximately 250,000 kw. at the present time. One-half to two-thirds of this is generated by water power, the balance by steam. Also in the distributing territory, which may be classified as Portland, Seattle and Tacoma, and Spokane, two-thirds of this total is either generated or distributed in the cities or the adjacent territory.

The present yearly increase in demand for electric power is between 20 and 30 per cent in all vigorous and growing sections of the Northwest. This means a required development yearly of from 50,000 to 80,000 kw. to supply this growing demand for electric power and while it constitutes but a small per centage of the total of possible developments, it represents a very heavy growth and points to great possibilities for future hydroelectric development.

The type of developments vary throughout the wide range of hydraulic possibilities, from very low heads to extremely high ones, that is from 10 to 1500 foot hydraulic heads. The topographical, climatic and hydraulic conditions where these developments are possible, vary as greatly as their hydraulic heads. So that which may hold good in one place, 50 or 100 miles away would not apply at all. The run-off of various streams, due to diversified topographical and climatic conditions, has a serious effect on the amount or sale of power by reason of its effect on the amount of settlement of the country and the consequent demand for electric power.

The cost of power plant development, dependent on these various conditions which I have enumerated, has a very wide variation from perhaps $50.00 per kw. to $250 per kw. of installed capacity of plants. This is also governed to some extent by the size of many of the proposed developments, the range of which may be said to vary from 100 kw. to 40,000 kw.

[1]Paper presented before Portland Section A. I. E. E., Jan. 16, 1912.

In connection with the market or gross income of the plant, the cost of operation is a matter of utmost importance. The fixed charges on most plants would be something like this: Interest 6 per cent, depreciation 7 per cent, taxes 2 per cent, total 15 per cent on the investment. To this must be added the administration cost of $1.00 to $3.00 per kw. and the labor cost of $1.50 to $12.00 per kw. of installed capacity. This variation in the labor cost may seem large, but is altogether dependent on the size of the plant as well as conditions of operation. I have known some small plants, where the power house labor charge was equal to the latter figure, or $12 per annum per kw., that were profitable and paying dividends. The fixed and operating charges I do not intend to carry beyond the point of delivery of the power to the substations, as from here the unit cost has a greater variation with each center of distribution and the method thereof. In addition to the investment and labor charges, there is an efficiency charge dependent on the methods of distribution, the conversion of the generated power to other kinds of current and the losses in distribution.

It is not my intention to discuss rates in this paper, as there are a multitude of different ones, but the question of interest to the investor is, what will the gross income be for the power house, both in the sum total per kw. of actual peak load and in the ultimate generating capacity of the power plant. This is foremost in the mind of the engineer in the investigation of proposed hydraulic development, and is the fact to be determined before any development can be started. Suppose we have arrived at the point with a development where the question of flow, dam, intake, flume and pressure pipes, power house and transmission are all behind us, and the question of market, annual growth and expectations are the matters to be determined. As a matter of argument I have taken the cost of development at $100 per kw. of power house installation to include transmission to the substations. In most developments, of this $100.00, $60.00 to $70.00 per kw. must be expended no matter what per cent of the possible power is generated. In contrast to this is the steam plant which can be and usually is built in sections, and even if the entire power house for the ultimate capacity of the plant is built, an expenditure of $20 per kw. of the ultimate capacity of the plant would be excessive. This would also include the real estate investment for the plant. As a matter of fact, steam plants are built in sections, and the capital invested is only expended as an increase in plant is needed. I do not wish to be considered as an advocate for steam development by this, but what I wish to show is that in many hydraulic developments, until a market is found for a large per cent of the power that can be generated, there is liable to be a large fixed operating charge against that for which the plant has a market, and which in many cases the gross income from the market is not capable of meeting. As an example in a development of say 10,000 kw. having a market for 2500 kw., the total installation expense for this plant would be one million dollars, and for the 2500 kw. at least $700,000 would have to be expended, of $280.00 per kw. for which the plant has a market. The fixed charge of this would amount to $42 per annum per kw., and the administration and labor charge at least $4 per kw. per annum, or a total of $46.00 per kw. per annum. If on the other hand there is a market for the total 10,000 kw. the fixed charge would become $15.00 per kw. per annum, and the administration and labor charge would be $2.50 per annum per kw. or a total of $17.50 per kw. per annum.

It is clearly seen by these figures that the gross income from your market must be large enough to cover the first case in order to render it profitable to develop the power, and when the full capacity of the plant is reached, the investment should be a very profitable one. I do not wish this cost of generation to be considered as applicable to any power plant, but it is a general average case. The above case cited is one of the most general which the engineer meets in his investigation of hydraulic development in the Northwest.

I have spoken of the market annual increase and expectations. Perhaps in this I have coined a new word, or at least a new use for one. Usually in many of the proposed developments which the engineer has to investigate, the market is short and after the annual growth is undergone, the promoters bring forth what I term "expectations." Nearly all of these some day will be tangible assets in the gross income of power companies, and they include such things as furnishing power for railroads, from transcontinental lines to branch systems; irrigation and drainage systems; heating; logging; the manufacture of iron and steel; pulp mills; the manufacture of ice; and many other applications, which could not be considered immediately unless the expectations were to be financed by the same people who develop the power and thereby find their own market.

The consolidation of many small plants will advance and aid in the development of hydroelectric power thereby making it possible to show economy by the operation of single power stations. The annual increase in the power demand of such consolidations will be in many cases met by the entire output of some one of the power developments. In other cases it will be possible to carry a slight loss for a year or two until a demand for the full power capacity is secured.

INTERURBAN ELECTRIC RAILWAY MILEAGE IN CALIFORNIA.

Figures compiled in the offices of Chief Engineer Thompson of the State Railway Commission show the mileage of the interurban railways in California now to be 1732.99. Electric roads operating only within the limits of various municipalities are not included in the figures. Of the 1732.99 miles of interurban roads 1082.95 are on the main line; 465.01, second track, and 175.03, sidings. The 1910 total was 1432.94, 1911 thus having gained 250.05 miles. The largest roads and their main-line mileage are as follows: Central California, 55.29; East Shore and Suburban, 17.15; Northern Electric, 108.81; Oakland and Antioch, 14.50; Oakland Traction, 101.47; Pacific Electric, 106.50; Pacific Electric, leased, 450.89; Petaluma and Santa Rosa, 31.60; Peninsula Railway, 41.85; San Francisco and Napa Valley, 33.84.

AN IMPORTANT LAW.

Numerous inquiries have come into the editorial department of the Journal of late relative to the interpretation of Chapter 499 of the statutes of California for 1911. This enactment was approved April 22, 1911, and is an act regulating the placing, erection, use and maintenance of electric poles, wires, cables and appliances, and providing the punishment for the violation thereof.

Section 1. No commission, officer, agent or employee of the State of California, or of any city and county or city or county or other political subdivision thereof, and no other person, firm, or corporation shall

(a) Run, place, erect or maintain any wire or cable used to conduct or carry electricity, on any pole, or any crossarm, bracket or other appliance attached to such pole, within a distance of thirteen (13) inches from the center line of said pole; provided, that the foregoing provisions of this paragraph (a) shall be held not to apply to telephone, telegraph or other "signal" wires or cables which are attached to a pole to which is attached no wire or cable other than telephone, telegraph or other "signal" wire or cable, except within the corporate limits of any city or town which shall have been incorporated as a municipality, nor shall the foregoing provisions be held to apply to such wires or cables in cases where the same are run from underground and placed vertically on poles, nor to "bridle" or "jumper" wires on any pole which are attached to telephone, telegraph or other "signal" wires on the same pole, nor to any "aerial" cable, as between such cable and any pole on which it originates or terminates, nor to wires run from "lead" wires to arc lamps or to transformers placed upon poles, nor to any wire or cable where the same is attached to the top of a pole, as between it and the said pole, nor to any "aerial" cable containing telephone, telegraph or other "signal" wires where the same is attached to a pole on which no other wires or cables than wires continuing from said cable are maintained, provided, that electric light or power wires or cables are in no case maintained on the same side of the street or highway on which said "aerial" cable is placed.

(b) Run, place, erect or maintain in the vicinity of any pole (and unattached thereto) within the distance of thirteen (13) inches from the center line of said pole, any wire or cable used to conduct or carry electricity, or place, erect or maintain any pole (to which is attached any wire or cable used to conduct or carry electricity) within the distance of thirteen (13) inches (measured from the center of such pole) from any wire or cable used to conduct or carry electricity; provided, that as between any wire or cable and any pole, as in this paragraph (b) named, only the wire, cable or pole last in point of time run, placed or erected, shall be held to be run, placed, erected or maintained in violation of the provisions of this paragraph; and further provided, that the provisions of this paragraph (b) shall not be held to apply to telephone, telegraph or other "signal" wires or cables on poles to which are attached no other wires, as between such wires and poles to which are attached no other wires or cables than telephone, telegraph or other "signal" wires, provided such wires, cables and poles are not within the corporate limits of any town or city which shall have been incorporated as a municipality.

(c) Run, place, erect or maintain, above ground, within the distance of four (4) feet from any wire or cable conducting or carrying less than six hundred volts of electricity, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, or run, place, erect or maintain within the distance of four (4) feet from any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity any wire or cable conducting or carrying less than six hundred volts of electricity; provided, that the foregoing provisions of this paragraph (c) shall be held not to apply to any wires or cables attached to a transformer, within a distance of four (4) feet, (measured along the line of said wire or cable) from the point where such wire or cable is attached to such transformer, nor to wires or cables within buildings or other structures, nor to wires or cables where the same are run from underground and placed vertically on poles, nor to any "lead" wires or cables between the point where the same are made to leave any pole for the purpose of entering any building or other structure, and the point at which they are made to enter such building or structure, and provided further, that as between any two wires or cables, or any wire or any cable run, placed, erected or maintained in violation of the provisions of this paragraph (c), only the wire or cable last in point of time run, placed or erected shall be held to be run, placed, erected or maintained thus in violation of said provision, and further provided, that where no more than one crossarm is maintained on a pole, all the wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarm on one side of the pole, and all the wires or cables conducting or carrying less than six hundred volts of electricity shall be placed on the crossarm on the other side of the pole, and further provided, that the space between any wire or cable carrying or conducting at any one time more than six hundred volts of electricity and any wire or cable carrying less than said voltage shall be at least thirty-six (36) inches clear measurement in a horizontal line; and further provided, that where two or more systems for the distribution of electric light or power occupy the same poles with wires or cables, all wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarms on one side of the pole, and all wires or cables conducting or carrying less than said voltage shall in such case be placed on the crossarms on the other side of the pole, and further provided, that the space between any wire or cable conducting or carrying at ony one time more than six hundred volts of electricity and any wire or cable conducting or carrying less than said voltage shall be at least thirty-six (36) inches in measurement in a horizontal line, and further provided that in such construction all crossarms shall be at least thirty-six (36) inches apart in a vertical line.

(d) Run, place, erect or maintain, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, without causing each crossarm, or such other appliance as may be used in lieu thereof, to which such wire or cable is attached to be kept at all times painted a bright yellow color; or, on such crossarm, or other appliance used in lieu thereof, shall be placed enamelled iron signs, providing, in white letters on a green background, the words "High voltage," and these letters shall be not less than three (3) inches in height, said signs shall be securely fastened on the face and back of each crossarm. The provisions of this paragraph (d) shall not be held to apply to crossarms to which are attached wires or cables carrying or conducting more than ten thousand volts of electricity, and which are situated outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(e) Run, place, erect or maintain any "guy" wire or "guy" cable attached to any pole or appliance to which is attached any wire or cable used to conduct or carry electricity, without causing said "guy" wire or "guy" cable to be effectively insulated at all times at a distance of not less than four (4) feet nor more than eight (8) feet (measured along the line of said wire or cable) from the upper end thereof, and at a point not less than eight (8) feet vertically above the ground from the lower end thereof; and further provided, that wherever two or more "guy" wires or "guy" cables are attached to a pole there shall be at least one foot, vertical space, between the points of attachment, and further provided that no insulation shall be required at the lower end of a "guy" wire or "guy" cable where the same is attached to a grounded anchor; none of the provisions of this paragraph (e) shall be held to

apply to "guy" wires or "guy" cables attached to poles carrying no wire or cable other than telephone, telegraph or other "signal" wire or cable, and which are situated outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(f) Run, place, erect or maintain, vertically on any pole, any wire or cable used to conduct or carry electricity, without causing such wire or cable to be at all times wholly encased in casing equal in durability and insulating efficiency to a wooded casing not less than one and one-half inches thick. The provisions of this paragraph (f) shall not be held to apply to vertical telephone, telegraph or other "signal" wires or cables on poles where no other than such wires or cables are maintained, and which are outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(g) Place, erect or maintain on any pole, or on any crossarm or other appliance on said pole, which carries or upon which is placed an electric arc lamp, any transformer for transforming electric currents.

(h) Run, place, erect or maintain any wire or cable carrying more than fifteen thousand volts of electricity across any wire or cable carrying less than said voltage or across any public highway, except on poles of such height and so placed at each crossing that under no circumstances can said wire or cable of said voltage higher than fifteen thousand volts in case of breakage thereof or otherwise, come in contact with any wire or cable of less than said voltage, or fall within a distance of ten (10) feet from the surface of any public highway; or in lieu thereof double strength construction may be installed, in which case the wires carrying a voltage higher than fifteen thousand volts shall, between the points of crossing, be of a cross-section area equal to at least twice that used in the line outside of such crossing, except where the conductor used is equal to four nought (0000) Brown and Sharpe gauge or greater, in which case the wires or cables will be considered as complying with the law.

(i) Run, place, erect or maintain any suspension wire to which is attached any "aerial" cable of "75 pair number nineteen Brown and Sharpe gauge" or over, or of "100 pair number twenty-two Brown and Sharpe gauge" or over, suspended from a crossarm, (or from any other structure or appliance from which said suspension wire is hung) by a single bolt and clamp without at the same time attaching said suspension wire to said crossarm, structure or appliance by an additional "safety" bolt and clamp (or other "safety" appliance for thus attaching said suspension wire) of tensile strength equal to the first herein said bolt and clamp.

Sec. 2. None of the provisions of the preceding section shall be held to apply to "direct current" electric wires or cables having the same polarity, nor to "signal" wires when no more than two (2) of such "signal" wires are attached to any one pole, provided, that none of such "direct current" or "signal" wires shall in any case be run, placed, erected or maintained within the distance of thirteen (13) inches from the center line of any pole (other than the pole or poles on which said wires or cables are carried) carrying electric wires or cables; and provided further, that as between any two wires, or cables, or any wire or cable run, placed, erected or maintained in violation of the provisions of this section 2 only the wire or cable last in point of time run, placed, erected or maintained shall be held to be run, placed, erected or maintained thus in violation of said provisions.

Sec. 3. No commission, officer, agent or employee of the State of California, or of any city and county or city or county or other political subdivision thereof, and no other person, firm or corporation shall run, place, erect or maintain any "span" wire attached to any wire or cable used to conduct or carry electricity, without causing said "span" wire to be at all times effectively insulated between the outer point at which it is in any case fastened to the pole or other structure by which it is hung or supported, and at the point at which it is in any case thus attached, provided, that such insulation shall not in any case be placed less than two (2) feet nor more than four (4) feet from said point at which said "span" wire is so attached, and that when in any case, such "span" wire is attached along its length to any two (2) such wires or cables, conducting or carrying electricity and extending parallel to each other, not more than ten (10) feet apart, such insulation shall not be required therein at any point between such parallel wires or cables; none of the provisions of this section (3) shall be held to apply where "feeder" wires are used in place of "span" wires.

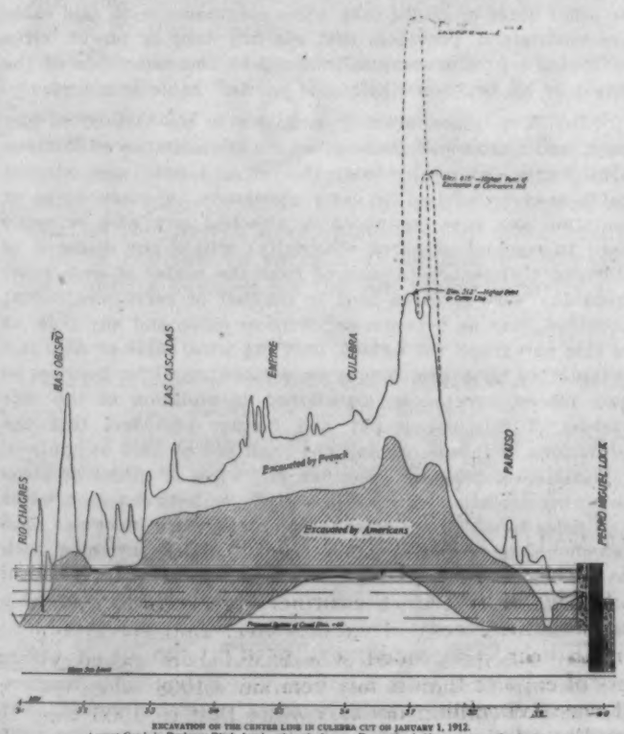
Sec. 4. Any violation of any provision of this act shall be deemed to be a misdemeanor, and shall be punishable upon conviction by a fine of not exceeding five hundred dollars ($500.00) or by imprisonment in a county jail not exceeding six (6) months or by both such fine and imprisonment.

Sec. 5. All acts or parts of acts which are in conflict with the, or with any of the provisions of this, act, are hereby repealed.

Sec. 6. This act shall take effect six months from the date of its passage in so far as it relates to new work, and a period of five years shall be allowed in which to reconstruct all existing work and construction to comply with the provisions of this act.

CULEBRA CUT—EXCAVATIONS IN DECEMBER AND FOR 1911 GREATEST OF RECORD.

The excavation in Culebra Cut in December 1,351,082 cubic yards, was the greatest accomplished in any December of the eight since the American canal work was begun. It brought the total for the year up to 16,596,891 cubic yards, and this is the greatest that



EXCAVATION ON THE CENTER LINE IN CULEBRA CUT ON JANUARY 1, 1912.
Lowest Cut is in Drainage Ditch, but is only a single cut. Excavation is 82 per cent completed.

has been accomplished in any year. The record for previous Decembers, and for previous years, compared with December, 1911, and the year 1911, follows:

Excavation in Culebra Cut, December, 1904, to 1911.

December.	Cubic Yards.
1904	42,935
1905	70,630
1906	307,689
1907	1,025,485
1908	1,210,046
1909	1,152,022
1910	1,211,400
1911	1,351,082

Excavation in Culebra Cut, years, 1904 to 1911.

Year.	Cubic Yards.
1904	243,472
1905	914,254
1906	2,702,991
1907	9,177,130
1908	13,912,453
1909	14,557,034
1910	15,398,599
1911	16,596,891
Total	73,502,824

There remain to be excavated 15,941,181 cubic yards, and the work in this part of the Canal is thus 82 per cent completed.

The high excavation is due to the fact that there has been very little rainfall in the territory of Culebra Cut during December, which is ordinarily considered one of the rainy season months.

Since December, 1907, the excavation has fallen below the million-yard-a-month mark only once, and the rate at which it has advanced during the year just closed is shown in the following statement:

Months	Cubic Yards.
January	1,356,394
February	1,409,338
March	1,728,748
April	1,414,336
May	1,299,100
June	1,401,016
July	1,337,833
August	1,442,402
September	1,340,173
October	1,306,971
November	1,209,498
December	1,351,082
Total	16,596,891

The work in December was done by 40 steam-shovels.

AMERICAN FOREIGN TRADE INCREASE.

The foreign commerce record of the United States for the calendar year 1912, so far as relates to total imports and exports, shows imports $1,532,931,-861, a larger total than in any year except 1910, which showed $1,562,904,151 as the value of imports. The exports of the calendar year 1911 were valued at $2,092,375,141, a larger total than in any preceding year, and considerably larger than the total of $1,923,-426,205 shown by 1907, the former high record year in exports. The excess of exports over imports in the calendar year just ended was $559,441,280, a larger excess of exports than in any year since 1908, when the total was 636 million dollars, while that of 1900 was 649 million dollars. The dutiable imports were $738,-481,025 in value; those free of duty, $794,450,836, the share entering free of duty being 51.82 per cent. The total commerce, imports and exports combined, was $3,625,305,002, against $3,429,163,055 in 1910, the former high record year in total trade.

AMERICAN GOLD AND SILVER OUTPUT.

The gold-mining industry was generally active in 1911, but early figures indicate that the total production for the United States and Alaska was slightly below that of 1910. The preliminary figures of the Director of the Mint indicate a total domestic gold output of $96,233,528 in 1911, against $96,269,100 in 1910. According to estimates made by the Bureau of Statistics, the imports in 1911 comprised gold valued at $11,150,000 in foreign ore, $29,300,000 in foreign bullion, $5,750,000 in United States coin, and $10,050,-000 in foreign coin—a total of $56,250,000. The gold exported in 1911 was valued at $500,000 in domestic ore, $8,050,000 in domestic bullion, $30,000,000 in United States coin, and $2,250,000 in foreign coin—a total of $40,800,000. The excess of imports over exports was about $15,500,000, indicating a marked change from the conditions in 1910, when the excess of imports over exports was $447,696, and also from those in 1909, when the excess of exports was $88,-793,855.

The gold imported in 1911 was mainly in the form of ore and bullion, and came chiefly from Mexico, although considerable gold is received from Canada every year, and smaller amounts from the Central and South American countries, and in 1911 a large quantity of gold was imported from Japan. The exports consisted largely of gold coin and went chiefly to Canada, although smaller shipments were also made to France, South America, the West Indies, and Japan.

Owing largely to the prosperity of the gold, copper, and lead mining industries there was an output of silver in 1911 estimated at 57,796,117 fine ounces, which is 2,182,997 ounces more than the average annual output of 55.615,120 ounces of the preceding decade and 658,217 ounces more than the output of 1910.

Preliminary figures compiled by the Director of the Mint indicate a total domestic production of silver of 57,796,117 fine ounces in 1911, valued at $31,787,866. The production in 1910 was 57,137,900 fine ounces, of a commercial value of $30,854,500.

The average price of silver in 1911 was 53 cents per fine ounce, a decrease of 1 cent from that of 1910.

The estimates made by the Bureau of Statistics place the imports of silver in 1911 at $27,450,000 in foreign ore, $12,850,000 in foreign bullion, $2,150,000 in United States coin, and $1,350,000 in foreign coin—a total of $43,800,000. The exports of silver during the same year were valued at $135,000 in domestic ore, $65,000 in foreign ore, $59,000,000 in domestic bullion, $4,750,000 in foreign bullion, $100,000 in United States coin, and $600,000 in foreign coin—a total of $64,650,000, or $20,850,000 in excess of the value of the imports.

In 1910 the value of the excess of exports over imports of silver was $11,482,805; in 1909 it was $11,404,607, and in 1908 it was $9,613.541. Previous to 1908 it had not been below $15,000,000 for several years.

The imports of silver in 1911 were, as usual, chiefly in ore and bullion and came mainly from Mexico and Canada. The exports were almost wholly in ore and bullion and went, as usual, chiefly to the United Kingdom and in smaller amounts to Hongkong and France.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year.	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Construction of the Stanislaus Line 87
By H. W. Crozier.
Preservation of Power Transmission Poles 92
By W. R. Wheaton.
New Incandescent Lamps Recently Standardized 92
Water Consumption from Indicator Card 93
By Robert Sibley.
Hydroelectric Enterprise in Peru 95
When Does It Pay to Develop Water Power? 95
By J. R. Thompson.
Interurban Electric Railway Mileage in California 96
An Important Law 97
Culebra Cut—Excavations in December and for 1911, Greatest of Record 98
American Foreign Trade Increase 99
American Gold and Silver Output 99
Editorials 100
An Important Law.
Panama Canal and Its Coast Influence.
Elegance.
Personals 102
Electrical Contractors' Notes 103
Northern California News 103
Southern California News 103
Los Angeles Section A. I. E. E. 103
Meeting Notices 103
San Francisco Section A. I. E. E. 103
Industrial 104
Printing Plant.
Development in Railway Apparatus During the Past Year.
Trade Notes 104
New Catalog 104

An Important Law

On April 22d last a law appearing as Chapter 499 in the 1911 Statutes of the State of California was approved. This law is an act regulating the placing, erection, use and maintenance of electric poles, wires, cables and appliances, and providing a punishment for the violation thereof. The complete details of this law will appear elsewhere in these columns.

As the provisions of this enactment did not become effective for new work until six months after its passage and as a period of five years is allowed in which to reconstruct all existing work, the contents of the act have thus far been almost wholly without discussion among the public service corporations of the State.

Now that new work is being undertaken in various parts of the Commonwealth of California, much agitation is rife as to its proper interpretation. In fact there is much reason for agitation for the law is grossly inconsistent in its terms. In the first place, under the heading (c), a corporation is forbidden to erect or maintain any cables or wires closer than four feet from center to center and yet toward the end of the same paragraph they are forbidden from placing any wires or cables less than thirty-six inches apart—inconsistency without question.

The provision relative to the placing of warning signs on high tension crossarms seem grossly unfitting and it certainly is deplorable that a committee of men versed in affairs of this nature should not have seriously gotten together to discuss these questions before the passage of the law.

The question of proper protection at the crossing of public highways is one that will certainly under the present provision of the statute bring an enormous burden to the high tension lines now transversing the State, and will cause thousands upon thousands of dollars in expense to meet these provisions. It seems that a much better protection could be secured by less drastic methods.

It is high time now, however, since the law has been passed and is now in force that corporations pay strict attention to its content for infringement is punishable not only by fine but imprisonment.

It would seem most highly profitable for all concerned that a committee representing a number of the corporations engaged in new work and in fact those operating old lines but which will have to be remodelled to meet the new conditions should meet at an early date to discuss the provisions of this act and see if it would not be possible to bring about needed changes and amendments to the law.

Panama Canal and its Coast Influence

Elsewhere in these columns will be found detailed the progress of affairs concerning the Panama Canal. When but mere children, we were held spellbound by the description of the adventures and conquests of the early Spanish soldiers of fortune. The unique civilization of the Aztecs, visited and vanquished by the dauntless Cortez, and the unique and picturesque life of the Incas, similarly visited and vanquished by the invincible Pizarro, have

ever been the fuel to aid the American boy in forming his ideas of constructive imagination. But in the light of the modern trend of events, no one picture could be painted that would show such a story without words as that of Balboa, climbing the heights of the Panama Mountains and for the first time gazing out upon the broad expanse of the great Pacific. The emotions experienced and dreams cherished by this Spanish adventurer were undoubtedly similar to those enjoyed by the world today, for this broad expanse beyond the seas will soon be opened for the first time, offering an opportunity for the building of new empires in the struggle for commercial supremacy.

The whole world is at present in a state of agitation and flurry. The daily Consular Reports teem with plans and dreams of aggrandizement on the part of the nations of the earth in their quivering expectation of what the Panama Canal will bring to them in the readjustment of the world's commerce.

Undoubtedly no truer saying has ever been uttered than that of "Westward, the course of empires takes her sway." The islands of the sea, the long stretches of coast bordering the Pacific, both in the Occident and Orient, daily turn their eyes toward Mecca, but when they awaken, no longer is it the Mecca of the Arabs' dreams but rather the gigantic task now under way in the little neck of land connecting North and South America. The daily papers are filled with the plans now being formed by the great ship owners' companies of the Atlantic, in which they announce that the tide of immigration will no longer pour into New York and other Eastern ports, but, by means of the Panama Canal, thousands of immigrants will be disembarked in the land, which Horace Greeley had in mind when he said "Go west, young man, go west."

Those who have given much study to this question of immigration predict for the coast States an unusually high type of immigrant. The lower forms, comprising the adventurer, will find their haven in the wilds of South America, Mexico, and Canada, but the higher type possessing some of the world's wealth, who have left their homes with some adventurous idea, it is true, but yet imbued with that higher idea with which our own citizens are endowed, will seek our shores for their permanent abode, because we have here everything to offer them in the way of the good things that life possesses.

The entire Pacific Coast presents opportunities for all who may desire to cultivate its soil or become a part of its commercial development. With every gift of nature, awaiting but the application of water, which can be pumped at reasonable figures by electrically operated mechanisms an empire of arid lands yearningly looks to the immediate future.

Elegance

In previous issues of the Journal we have called attention to the fact that above all other qualities of style in technical writing an engineer should possess clearness of expression. Second in importance we have found that, especially when an engineer through his written report desires to move men to action, his writing should possess force. We come now to a discussion of still another quality which seems to be almost totally lacking in technical literature of today, elegance of expression.

The gigantic commercial development among our industries has been such an absorbing topic in our matter-of-fact literature, the esthetic side of our engineering nature has been almost entirely neglected. Faint signs however of a new awakening looking toward this higher development are daily coming into our engineering life. Not so much is this true in the style of technical literature as in the style of engineering design.

A few years back a structure was built mainly to meet the matter in hand without any idea as to its beauty or the effect it might have upon the mental make-up or development of those who should cast their share of life's fortunes with it. But now we see the engineer arousing from his slumbers. The style of architecture in our power houses, the grounds surrounding them and even the carefully finished design of the machinery itself bears the stamp of evolution into a higher plane of engineering thought. Unquestionably such higher development will in the future imbue our engineers with a keener and higher appreciation of life and such higher ideals being instilled will induce greater loyalty and higher conceptions of obligation to the employer.

Elegance of expression or in other words, a style adopted to touch the esthetic side of our natures seems however wholly lacking in our technical literature. Why should we not, nevertheless, enrich our literature with this side of technical writing? It seems now to have permeated every other phase of our social and economic development.

Technical design and industry are having a deep and unspeakable influence in shaping our commercial and industrial progress. Why, then, should not the onward march of our technical literature tend towards heightening our general esthetic make-up? The one trait of expression which lends itself so wonderfully in appealing to our esthetic natures is that of adaptation to the matter in hand. Sympathetic vibration with those before whom our thoughts are to be presented can only be gotten by this adaptation which is technically called elegance.

Our technical literature with its figures and summarized facts have in the past largely served to portray socalled progress—money made or money lost. The eager technical reader in the recent years of unprecedented material growth has sat by and devoured the dry morsels thus handed out to him with the same avidity that the wild beast at the "zoo" takes hold of raw meat flung at him by the game tender, and if we listen we can almost hear our technical habits described by the loud-voiced one without as he yells: "Come in—come in—and see 'em—eats 'em alive."

No set rules seem to have ever been put forth by which one may attain elegance in expression. Like the symphony in the music of the spheres, one possessing elegance must be entuned with the Infinite. The true engineer in contemplating the wonders of scientific achievement has felt its inner charms. Should a Milton, a Dante, or a Shakespeare ever come to earth as an engineer it would indeed be difficult to foretell to what heights the ideals of men would be raised.

PERSONALS.

O. W. Lillard, Pacific Coast manager of the Gould Storage Battery Company, is at Seattle.

H. L. Middleton, who has local electric lighting interests at Boulder Creek, is at San Francisco

F. B. Baum, of F. G. Baum & Company, has returned to his San Francisco office from Southern California.

T. J. Patterson, who operates the United States Government wireless telegraph station at Juneau, Alaska, is at San Francisco.

R. G. Hanford, who is prominent in the management of the United Properties Company, is at New York on business of importance.

A. L. Walton has been appointed chief clerk to the general purchasing agent of the Pacific Electric Railway Company, of Los Angeles, Cal.

P. Endert, an electrical contractor of Bakersfield, is at San Francisco on business which is said to be connected with an oil land project.

George E. Pillsbury, chief engineer of the Pacific Electric traction lines of the Southern Pacific Company at Los Angeles, is at San Francisco.

J. W. White, of the sales force of the Fort Wayne Electric Works, has returned to the San Francisco office after a tour of Southern California.

H. V. Carter, president of the Pacific States Electric Company, left for Portland this week and will return to San Francisco about the end of February.

F. R. Ford of the New York engineering firm of Ford, Bacon & Davis, has arrived from the East and will spend some time at the San Francisco office.

R. S. Daniels, assistant to the electrical engineer of the Washington Water Power Company of Spokane, has been visiting in Los Angeles and is now at San Francisco.

Frank M. Lewis, in charge of the construction department for the Van Emon Elevator Company, left San Francisco Monday for his new field of duties in Vancouver, B. C.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard and Supply Company of Chicago, leaves the first of next week for a business tour of Southern California and Arizona.

A. C. Balch, who is interested in the management of the San Joaquin Light and Power Corporation, and is also a shareholder in the Midway Gas Company, was a recent arrival at San Francisco.

A. H. Koehig and A. H. Koehig, Jr., consulting hydraulic and civil engineers, have removed their offices from 902 Broadway Central Building to suite 841 Title Insurance Building, San Francisco.

Harry R. Noack, president of Pierson, Roeding & Co., has returned to San Francisco after an extended stay in the Pacific Northwest, where his firm has two branch offices—at Seattle and Portland.

William Hoopes, electrical engineer for the Aluminum Company of America, with works at Pittsburg, is at San Francisco, making his headquarters with Pierson, Roeding & Co., the Pacific Coast agents for his firm.

J. S. Cain of Bodie, who has been prominent in mining enterprises there for a quarter of a century, and during the past few years has founded the Pacific Power Company and the Southern Sierras Power Company, spent the past week at San Francisco in connection with plans for the completion of the latter development.

Chief Engineer Stowell of the Mt. Whitney Power Company, of Visalia, is at the Lane Hospital, San Francisco, undergoing treatment, but will soon be out.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, leaves the first of next week for Seattle and will spend several days at the Northwest agency.

Tully R. Connick, contracting engineer on steel tower transmission lines, of Petaluma, Cal., was an interested attendant at the recent San Francisco branch meeting of the American Institute of Electrical Engineers.

Ralph Bennett has resigned as chief engineer of the Great Western Power Company, San Francisco, to accept the position of chief engineer of the Dominguez Land Company, Title Insurance Building, Los Angeles.

Albert Meinema, city sales manager of the Electric Appliance Company's San Francisco house, has been elected a member of the National Sales Managers' Association. A branch of the association was recently organized at Los Angeles.

R. D. Holabird, president of the Holabird-Reynolds Company, who returned to San Francisco during the past week after visiting the Pacific Northwest, will in future spend about half of his time at Seattle with the Holabird Electric Company.

Y. Ishakawa, electrical engineer in charge of the 10,000 h.p. steam and hydroelectric installation of Kyoto, Japan, was a recent interested spectator at the test of the new 12,000 kw. turbine at Station C of the Pacific Gas & Electric Company, in Oakland.

S. P. Russell, manager of H. W. Johns-Manville Company's electrical department at San Franicsco, left for an eastern trip during the past week. While in the East Mr. Russell will attend the convention of the company's electrical managers.

R. J. Chapman has become associated with J. W. Swaren, technical advertising consultant at San Francisco. Mr. Chapman has had a wide engineering experience, and for the past four years was general manager of the Fowler Utilities Company, Fowler, Indiana. Mr. Chapman received his engineering training at Purdue University and Leland Stanford Jr. University.

J. H. Siegfried has resigned as superintendent of the light and power department of the city of Winnipeg to accept a position with the Pacific Power & Light Company as superintendent of power. In this position Mr. Siegfried will have jurisdiction of all generating stations, transmission lines and substations owned by the company in Yakima, Walla Walla and Columbia River valleys.

Robert McGlynn, who has been connected with the Smith-Tevis electric interests for the past four years, resigned his position as chief engineer of the four electric power stations of the United Light and Power Company at San Francisco, February 1st. After eleven years of active work in electrical engineering lines, Mr. McGlynn intends to spend a few months in travel, and then return to choose a new position out of several that have been offered him. It is understood that no successor is to be appointed as chief engineer.

Sam P. Russell, manager of the electrical department of the H. W. Johns-Manville Company's San Francisco office, is at New York to attend the forthcoming annual convention of the various managers of that department throughout the country. F. S. Mills, electrical manager of the company's Los Angeles branch, and F. W. Loomis, manager of the electrical department at Seattle, will also attend the convention. George G.

Gunderson, who was recently succeeded by Loomis, accompanied the latter to New York. For three days the convention will be held at New York and three days at Hartford, Conn., where H. W. Johns-Manville Company's factory is situated. J. H. Davier, Russell's assistant, is in charge at San Francisco during his chief's absence.

Garnett Young, manager of the San Francisco office of the Telephone-Electric Equipment Company, announces that the Seattle branch, F. G. Larflin, manager, has removed from the Manufacturers' Exchange Building to a choice location at 1002 First avenue South. The change was made absolutely necessary by increase in the business and three times the space occupied at the old location is now available.

SOUTHERN CALIFORNIA NEWS.

The city of Pomona will install a decorative street lighting system in their city park, within the next ninety days.

The city of Glendale will vote on a $40,000 bond issue, on February 2d, to be used for extensions and betterments on their municipal lighting plant.

The Pacific Electric Railway Company has been given 90 days to relieve the congestion on Main street. How this is to be done the council does not suggest, but simply states that it must be done.

The local fire alarm situation in Los Angeles is still in abeyance, the matter now being in the hands of the city attorney, to submit his opinion on the legality of the specifications. The matter is still too indefinite to give any reliable information, but the subject is certainly one that is becoming very interesting to the observer.

The City Council of Los Angeles passed an ordinance forcing the lighting and telephone companies underground, in a district comprising two miles of streets in the business district. The exact locations have not been determined as yet. They also decided against a petition from the residents on Moneta avenue for an underground system comprising about two miles.

The Los Angeles council has rejected the compromise offered by the Home Telephone & Telegraph Company, regarding the rate controversy and have recommended another expert to be employed to reappraise the plant. This plant has already been appraised by Mr. Sloan, of the Public Utilities Commissioners of Wisconsin, and Mr. Kempster B. Miller, but because their report carried with it a recommendation for the increase in rates, the council would not accept it as final and are still endeavoring to reduce the rate, instead of bringing it up equal to the Pacific Telephone & Telegraph Company's rate.

LOS ANGELES SECTION A. I. E. E.

At the meeting held January 23d two papers were presented, one by Mr. E. Y. Porter, on "Show Window Lighting," and one by Mr. F. B. Lewis of the Edison Company, on "Practical Illumination. These papers were discussed by Prof. Nye, of the University of Southern California, who gave some interesting lantern slides of color effects, also Mr. Mills, of the Johns-Manville Company and Mr. Manahan, city electrician, also a general discussion by different members. Mr. Lewis gave a practical demonstration of his paper, showing the light effects as reflected by different colors, explaining the results to be had by given illumination in rooms finished in different colors. The papers were interesting to the members present, inasmuch as it is a subject that has been very much neglected and is of really great importance, not only in residences, but offices and elsewhere.

SAN FRANCISCO SECTION A. I. E. E.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers met at the Home Telephone Company's building Friday evening, January 26. An interesting paper was read by Otto E. Falch on the design of transmission lines. This paper was followed by a lantern slide lecture on the Stanislaus transmission line construction by H. W. Crozier. Mr. Crozier's paper appears elsewhere in these columns. Mr. Falch's paper will appear in the next issue of the Journal.

MEETING NOTICES.

The San Francisco Section of the American Institute of Electrical Engineers will give a dinner at eight o'clock, Saturday evening, February 3d, at the Old Poodle Dog Restaurant, 421 Bush street, in honor of Bion J. Arnold, past president of the Institute.

The Electric Development League will hold its regular monthly luncheon on February 6th at 12:30 p. m., at the Press Club rooms in the Commercial Building, 833 Market street. A debate will be held on the question, "Resolved, That it is to the best interests of central stations to sell incandescent lamps." All electrical men are invited to attend.

NORTHERN CALIFORNIA NEWS.

President H. H. Noble announced that the Northern California Power Company has completed negotiations for the purchase of the properties of the Sacramento Valley Power Company. Two hydroelectric plants are included in the sale. The Sacramento Valley Power Company represents a merger er which was effected about a year ago, of the Shasta Power Company and the Northern Light and Power Company. Herbert Fleishhacker and Mortimer Fleishhacker of San Francisco and E. B. Smith of Redding are members of the selling syndicate.

Northern California Power Company's system.

The two plants acquired in Eastern Shasta County will be tied in at once with the five hydroelectric stations of the

ELECTRICAL CONTRACTORS' NOTES.

E. C. Burkhard, of Palo Alto, was in San Francisco recently on business.

W. S. Hanbridge spent last Monday in Sacramento and Tuesday in Stockton on electrical contractors' business.

H. C. Reed superintendent for the Pacific Fire Extinguisher Company, is at Portland looking after the company's interests there.

Mayor Rolph of San Francisco has called together a committee of contractors, composed of P. Decker, F. Watts and W. S. Hanbridge, in conference with Police Commissioners Cook and Woods, Fire Commissioner Brandenstein and Supervisor McLaren, chairman of the Building Committee. The subject of discussion was in reference to the Chief of Department of Electricity. The contractors were asked in reference to the ability of a number of applicants for the position. The subject of the alleged incompetence of the present chief was spoken of quite freely, but contrary to all daily paper reports, the contractors filed no charges against the chief. The contractors impressed upon the administration that they did not want to name a new chief, but to make sure that the man who would be appointed would give the contractors, dealers and consumers a fair deal, and at the same time not jeopardize the utility of the fire alarm telegraph systems.

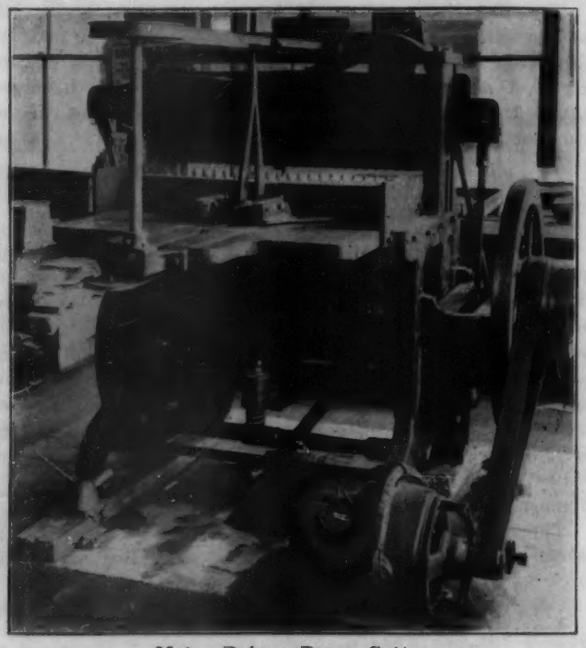
The list of names submitted is a good one, with a couple of exceptions, and from such a body of men the city officials will find a man who will be a credit to the office.

INDUSTRIAL

PRINTING PLANT.

Progressive printers are beginning to realize the manifold advantages of an electric drive for their printing shops. They readily perceive how easy it is to eliminate the long lines of shafting with belts to each machine dripping oil, difficulty of speed changing and the lack of economy in running all the shafting when it is desired to operate only one machine.

By the use of individual electric drive, machines may be located in the most convenient places for the work they are to perform, rather than in a row so as to be driven from one line shaft. In this manner, each operator can run his machine regardless of the others. The shop of Kohn & Pollock, Baltimore, Maryland, is an excellent example of the improvement to be secured from the electrification of a printing plant.



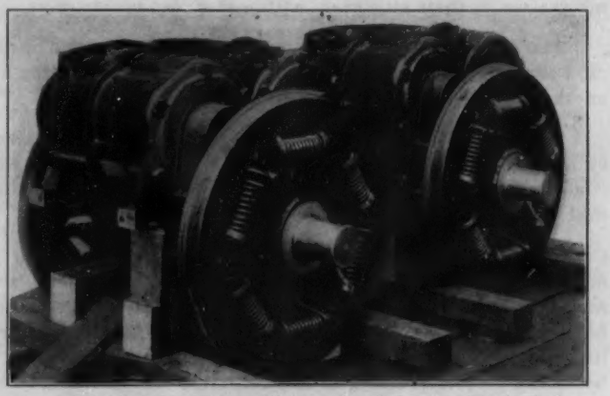
Motor Driven Paper Cutter.

Since the installation of individual motor drives, the average cost of energy per month has decreased, and in addition, when the output of the plant was curtailed for any reason, the power bill was decreased in proportion, which, of course, was not true under the former system. The electrical equipment of the plant includes fifteen constant speed direct current Westinghouse type R motors, aggregating 21½ horsepower. All of the motors were furnished by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

DEVELOPMENT IN RAILWAY APPARATUS DURING THE PAST YEAR.

During the year just past, considerable progress has been made in the development and improvement of electric railway aparatus. The increase in the number of applications of the single-phase system has been particularly noteworthy. The latest single-phase locomotive built by the Westinghouse Company is equipped with four driving axles. There are two single-phase motors geared to a quill surrounding each axle. This arrangement, which at first appears more complicated, is in reality, a lighter, cheaper, and more simple construction than that involving four motors of the same total capacity.

Most of the troubles on pioneer single-phase railways were due to operation at abnormally high speeds, at speeds higher than those for which the equipments were designed. These high rates of speed were possible because the line voltage was always good and because the transformers were usually supplied with over-voltage taps. Furthermore, the motors had very steep speed characteristics, which permitted them to reach a higher speed than would be possible with a direct current motor with the same gear ratio. This source of trouble is now eliminated in Westinghouse equipments by the use of an overspeed relay, which is electrically operated, and is controlled by the current and voltage applied to the motor through the control circuit. When the speed of the motor reaches a certain predetermined limit, the control circuit is opened on the higher notches of the controller. This makes it impossible to operate the cars above the limit unless there is a long stretch of down-grade, which is unusual on interurban lines. In any event, excess speeds are possible only when there is no power on the motors. This method of protection might safely be applied to direct-current motors, since extremely high speeds are not only dangerous, but in nearly all cases are unnecessary. High speeds are a source of expense because of the extra energy consumption



New Type of Mounting Motors in Pairs on Each Axle.

TRADE NOTES.

The Stanton Dielectric Rubber Company of Muskegon, Mich., because of a conflict in names will hereafter be known as the Vulcanized Products Company and their dielectric material called Dielectrite will be renamed Gohmak.

The Moloney Electric Company of St. Louis, with works at that city and at Windsor, Canada, have opened a San Francisco office, in charge of R. B. Elder, in his permanent office on the ground floor of the Rialto Building. The Moloney Electric Company specialize exclusively on the manufacture of transformers and the San Francisco office is fully equipped with such detailed information as may be required by any purchaser.

NEW CATALOG.

The Worcester Polytechnic Institute has just issued an attractive catalog of 250 pages covering items of interest concerning the Institute for 1911-1912.

NEWS NOTES

INCORPORATIONS.

SAN JOSE, CAL.—Saratoga Telephone Company, for $9000, shares at $10 each, $1560 subscribed by A. B. Brolly, F. J. Currier, R. L. Hogg, J. A. Kerr, L. J. Church and others.

ILLUMINATION.

GERVAIS, ORE.—An agitation is being set on foot for electric lights in this town.

WESTON, ORE.—The Preston-Shafter Milling Company, Athena, will rebuild its light plant here and install modern machinery.

WOODVILLE, ORE.—The Rogue River Electric Company will supply electricity to the town as soon as the transformer station is completed.

PORTLAND, ORE.—The Oregon-Idaho Light & Power Company has been granted a franchise for an electric light plant, power and heating service; the city is to establish the rates.

BELLINGHAM, WASH.—Business men here are agitating the purchase and installing of cluster lights on parts of Holly, Bay and Prospect streets, 50 in all, for which the cost will be about $3750.

PARIS, IDAHO.—The Telluride Power Company has been granted the right to maintain an electric light and power transmission system on and over the streets, alleys and public places of this city.

ELLENSBURG, WASH.—S. Bornstein, of Seattle, made application to the City Council for a gas franchise; he offers a guarantee of $2000 and a gradually increasing percentage of the gross receipts.

GLENDALE, CAL.—A special election will be held February 2 for the purpose of voting on the question of issuing $40,000 in bonds for acquiring, constructing and completing a municipal electric light works in the city.

BELLINGHAM, WASH.—An appropriation of $6000 from the funds of the water department was made by the City Council for the purchase and installation of the required equipment for the proposed city auxiliary electric lighting plant.

NEVADA CITY, CAL.—The trustees have decided to take up the project of establishing a municipal lighting system. The Pacific Gas & Electric Company, which owns the system now supplying the city with light and power, will be asked to name a figure which it will accept for its plant in this city.

FRESNO, CAL.—W. N. Henderson, local manager for the Pacific Gas & Electric Company, announces that his company plans the erection of a $60,000 brick and stone structure for its offices in Fresno. The building and site will cost somewhere in the neighborhood of $50,000 and plans will be ready within a few weeks.

TRANSMISSION.

MODESTO, CAL.—The board has granted permission to the Sierra & San Francisco Power Company to maintain an electric transmission line in certain parts of Stanislaus county.

SAN FRANCISCO, CAL.—Kalenborn & Pahl, electrical contractors, report the completion of a difficult job of submarine cable work for the U. S. Government which has recently connected Angel Island with an 11,000-volt power cable to the mainland at Tiburon across Raccoon Straits .

BRIDGEPORT, WASH.—J. E. Brayton of the Nixon-Kimmel Company, Spokane, has asked the City Council for a franchise to construct light and power lines over the streets and alleys here.

LEWISTON, MONT.—The Butte Electric & Power Company will build a high tension power transmission line from Rainbow Falls to Lewiston this summer. The distributing system in Lewiston will also be rebuilt.

SEATTLE, WASH.—The contract for the complete electrical system for the 42-story L. C. Smith building, to be erected at the corner of Yesler Way and Second avenue, has been let to the Empire Construction Company.

HUSUM, WASH.—Work on the $1,000,000 power plant of the Northwestern Electric Company, four miles down the White Salmon River, will be pushed to completion as soon as the snow disappears. Large donkey engines were hauled up from Underwood, to be used in excavating for the concrete dam.

GARDNERVILLE, NEV.—William Scheele & Dick Thran have made application for a franchise right to operate an electric plant and transmit electricity along a certain route. The franchise calls for a period of 25 years. On March 4th at the office of the board, at Genoa, Nev., a meeting will be held for a hearing of the said petition.

SEATTLE, WASH.—Voters will be asked at the city election in March to approve bond issues of $1,000,000 and $640,000 for additional light and power sites on the White River and Lake Cushman, respectively, as the result of a meeting of the council. The issue, if approved, will include the purchase price of the land and the cost of installation of the power plants. It is proposed to utilize the Lake Cushman site for power for industrial establishments for this city. John C. Higgins, representing John E. Wickstrom, owner of the riparian rights and land in the tract, said that if the city declined to take over the lands they would be used for a private plant for the development of light and water power.

SAN FRANCISCO, CAL.—The work of laying 20,000 feet of cable from the Oakland shore to San Francisco, connecting the distributing stations of the Great Western Power Company and the City Electric Company has been completed. With the new cable in working order the San Francisco district of the Great Western Power Company will have a much improved service, getting its power directly from the main station on the Feather River, 165 miles away. About six months have been consumed in laying the cable, which is believed to be the largest and longest of its kind ever laid. The cable, which is six inches in diameter, will furnish 5000 kilowatts of power. It is protected by two shields of metal. one of lead and another of steel, with a compound substance between the shields. The cost of the power cable was about $250,000.

TRANSPORTATION.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been granted the right to electrify the Santa Monica air-line.

SALEM, ORE.—The Oregon Electric Railway Company promises to build a commodious new depot here within a short time.

PASADENA, CAL.—The Southern Pacific Company has been granted a franchise to extend its road out Washington to Wilmington street.

BILLINGS, MONT.—Trolleyless cars have been introduced on the electric system here. Power is drawn from storage batteries on the cars.

PHOENIX, ARIZ.—An application for a franchise for the proposed White line to Mesa and Scottsdale, has been made by the Salt Lake River Valley Electric Railway Company.

MOSCOW, IDAHO.—The Inland Empire Railroad will begin work at once on the new depot for this city, to be a duplicate of the new station at Colfax. The cost will be $4000.

BELLINGHAM, WASH.—Nooksack Valley Traction Company has secured an extension of the limit of its franchise for the construction of an electric line. Work must begin within nine months.

BOTHELL, WASH.—A. K. Rouse, representing Chicago capital, has asked for a franchise to build an electric line in Bothell, for street cars and light. The line is to be built into Seattle later.

NAMPA, IDAHO.—The Southern Idaho Heat, Light & Power Company has secured a site for a depot for the Nampa-Caldwell electric line. A fine depot will be constructed this spring.

MARSHFIELD, ORE.—Directors of the Terminal Railway have ordered work to proceed on the first mile of the line out of here. Two electric passenger cars will be ordered at once in San Francisco.

EL PASO, TEX.—The Stone-Webster corporation is considering the project of constructing a valley electric line from El Paso through El Paso valley to Socorro or some other point in the lower part of the valley.

LOS ANGELES, CAL.—Vice-President Paul Shoup of the Pacific Electric Railway has announced that the company will spend something like $100,000 in improving its terminal facilities at Sixth and Main streets.

SUTTER CITY, CAL.—Offers of a free right-of-way and the purchase of stock of the Marysville-Colusa Railroad have been made to the Northern Electric Company, which will build through to Sutter City.

WENATCHEE, WASH.—Bonds of the Wenatchee Valley Railway & Power Company have been sold to the amount of $1,000,000. The company will construct a trolley from Malaga to Leavenworth, 60 miles long.

LEBANON, ORE.—A surveying crew is at work running lines up the Santiam River. No information is available, but it is believed the crew is in the employ of the Oregon Electric and that a line to Sweet Home will be built.

LOS ANGELES, CAL.—The new shops of the Pacific Electric Railway Company at Dominguez, the industrial city, will be built at a cost of $750,000 instead of $250,000 as previously announced, according to a statement of Paul Shoup, vice president.

SACRAMENTO, CAL.—The Vallejo & Northern Railway Company has applied for a franchise for lines on Second street, between K and M streets, and thence on M to the middle of the Sacramento river, and on Front street, from R to M, and thence to the center of the river.

MONROVIA, CAL.—General Superintendent Pratt, Division Superintendent Whelan, and other Southern Pacific officials, inspected the Los Angeles-Monrovia spur of the Southern Pacific recently. The party came in a special train and devoted considerable time to a careful investigation of switching and yard facilities at the station. No hint of the purpose of the trip was vouchsafed but it is believed that the often-discussed project of electrizing the line is again under consideration. The announcement that electric traction will soon displace steam on the Los Angeles- Pasadena branch supports this conjecture, which is further strengthened by the fact that the region traversed by the Monrovia line is rapidly building up and only awaits frequent service to become as densely settled as the district contiguous to the Pacific Electric.

LODI, CAL.—It is reliably reported that the Central California Traction Company has secured rights of way for a branch line from its main Sacramento line at Galt road to Galt, and that it proposes to extend the branch line through Thornton and on to Walnut Grove on the Sacramento River.

PASADENA, CAL.—The Pasadena Rapid Transit Company, whose aim it is to establish a twelve-minute railway service between this city and Los Angeles, has taken the first step in proceedings for the creation of a bond issue to finance the undertaking. At a recent meeting it was decided by the company that the proposed bond issue will be $2,000,000 instead of $3,000,000 as was contemplated.

STOCKTON, CAL.—In all probability the Central California Traction Company will shortly apply to the City Council for a franchise to operate its lines along Tuleberg Levee to the Crown Mills. Councilman O'Keefe suggests that the city build a belt line on the waterfront and allow all companies to use it.

FOREST GROVE, ORE.—The council has granted a franchise to the Oregon and California Railroad Company, which grants the right to lay, construct and maintain street car tracks and to operate and maintain power, telephone and telegraph lines in this city. Construction work is to be completed within 8 months.

TELEPHONE AND TELEGRAPH.

GLASGOW, MONT.—The operating room of the Moore telephone exchange was destroyed by fire recently.

ST. JOHNS, ORE.—The Mount Hood Railway and Power Company will as soon as possible install their own telephone system in their plants and offices.

MEDICAL LAKE, WASH.—Negotiations are on for the purchase of the Medical Lake telephone line by the Pacific States Telegraph & Telephone Company.

EUGENE, ORE.—A. E. Cohoon, supervisor of Suislaw National Forest, is seeking a franchise over roads in western Lane county, for a government telephone line.

SEATTLE, WASH.—Word is received here that the Marconi Wireless Telegraph Company will equip fourteen vessels on the Pacific Coast and that in a short time the company will open a station in Seattle.

WALLA WALLA, WASH.—The Western Union Telegraph Company's office in this city are to be moved from their present quarters in the Pain building on South Second street to the Podigo-Lonoy building on North Second street.

GOLDENDALE, WASH.—The Lyle Telephone Company has been granted permission to maintain a telephone line along the public highways in the districts tributary to Lyle, upon the express condition that public travel shall not be interfered with.

MARTINEZ, CAL.—The Pacific States Telephone & Telegraph Co. directors met here the other day and re-elected Henry T. Scott of San Francisco, president; E. C. Bradley, vice-president and general manager, and F. W. Eaton, secretary and treasurer, in addition to twelve directors. From now on the directors will hold their meetings at the general offices in San Francisco.